HOUSE OF LORDS SESSION 1993-94

SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

INTERNATIONAL INVESTMENT IN UK SCIENCE

EVIDENCE

Ordered to be printed 31st October 1994

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CALL FOR EVIDENCE

Sub-Committee I (Lord Walton of Detchant, Chairman) has begun an enquiry into International Investment in UK Science, and invites written submissions on this topic. The Committee aims to make a report to the House of Lords by July.

By "International investment in UK science", the Committee means overseas investment in research in science, engineering or medicine carried on in the UK, whether for civil or defence purposes. We are interested in investment from overseas sources, whether commercial or public-sector, and whether from within or outside the EC. We are interested in such investment in any form: research units, either free-standing or associated with a manufacturing plant; research contracts with universities, Research Councils, government research establishments or the private sector; undirected funding of science (eg supporting a chair); support of overseas research students (though we do not intend to reopen the question of the fees charged to such students); or other modes. In the case of a multinational company or international collaborative research programme, we are interested only to the extent that research conducted in the UK is supported by funds allocated overseas.

The Committee seeks answers to the following questions:

1. What is the extent, nature and variety of overseas investment in UK science? How does this compare with investment by UK interests in science overseas?

2. What factors influence potential investors in deciding whether to come to the UK for science, or to go elsewhere? (whether elsewhere in the EC, or elsewhere in the world)

3. What are the benefits to the parties concerned, and the wider UK economy? (both short- and long-term, both tangible and intangible - including such matters as training, employment, intellectual property, access to and exploitation of results, one form of investment attracting another)

4. What is the level of expenditure by investors, and are there costs (direct, indirect or intangible) to the hosts?

5. What are the policy implications for the British government and British science?

INSTRUCTIONS TO WITNESSES

Evidence should be submitted to the Clerk of Sub-Committee I (International Investment in UK Science), Select Committee on Science and Technology, House of Lords, LONDON, SW1A 0PW.

The final deadline for submissions is 29 May.

Evidence must be clearly typed or printed on one side of A4 paper and take the form of an original copy. Long submissions should include a summary. Evidence becomes the property of the Committee, and may be printed. You may publicise your evidence between submission and publication, but in doing so you must indicate that it was prepared for the Committee.

Persons who submit written evidence may be invited to give oral evidence. Oral evidence is usually given in public at Westminster, and transcripts are published.

You may follow the progress of the enquiry from the Weekly Agenda of House of Lords Select Committees. This is free, and may be ordered from Miss Sue Hunt, Committee Office, House of Lords, LONDON, SW1A 0PW (071-219 5791).

Further information from the Clerk, Andrew Makower, House of Lords, LONDON, SW1A 0PW. Tel: 071-219 6798, Fax: 071-219 6715.

Members of Sub-Committee I are:

L. Butterfield
L. Dean of Beswick
L. Desai
L. McColl of Dulwich
L. Nathan
L. Nelson of Stafford
B. Perry of Southwark
L. Perry of Walton
L. Porter of Luddenham
E. Selborne
L. Tombs
L. Walton of Detchant (Chairman)

MINUTES OF EVIDENCE

TAKEN BEFORE THE SCIENCE AND TECHNOLOGY COMMITTEE

WEDNESDAY 23 FEBRUARY 1994

Present:

Butterfield, L.
Desai, L.
McColl of Dulwich, L.
Nelson of Stafford, L.
Perry of Walton, L.
Porter of Luddenham, L.
Selborne, E.
Walton of Detchant, L. (Chairman)

Memorandum by Imperial College

Answers to possible questions as supplied by the Sub-Committee Secretariat:

1. *Please describe the extent and manner of overseas investment in your departments concerned with science and technology. We are interested both in research and post-graduate students.*

Over the four years between 1 August 1989 and 31 July 1993 the average value per annum of new projects accepted into Imperial College's portfolio of Research Grants and Contracts was £46.5 million. The portfolio included 2,602 research projects during the period.

Of these, 495 (ie 19.0 per cent by number) were supported by overseas organisations. Their annual value was £8.7 million (ie 18.7 per cent by value of all Research Grants and Contracts accepted). The source of funds by country was as follows:

	£m	*% of whole portfolio*
European Commission Programmes	4.397	9.5
European Union countries	0.344	0.7
Non-EU Europe	0.664	1.4
USA	1.496	3.3
Japan	1.005	2.2
All others	0.782	1.6
Total	8.688	18.7
(UK	37.851	81.3)

It should be noted that the Japan entry in the above table includes a one-half contribution of £0.625 million per annum from the Japan Research and Development Corporation (a body of the Japanese Government) towards a major joint project in microelectronics also supported by the UK Science and Engineering Research Council. This project stemmed from an agreement reached at Prime Ministerial level on co-operation in science between UK and Japan.

A further type of research support is via Sponsored Posts. The income of Imperial College from this source in 1992–93 totalled £1.7 million. Slightly less than 20 per cent of this income came from companies whose principal operating base is not in the UK.

In 1992–93 the College had 509 PhD students from outside Europe, producing income from fees of £3.8 million.

Imperial College was given The Queen's Award for Export Achievement 1990 for its contribution to invisible exports in the form of fees paid by overseas students attending the College and commissioned research from overseas organisations.

2. *(For Oxford)*

3. *Do you actively seek overseas investment? How? From which countries?*

Because of the international nature of research, academics from Imperial College are constantly in contact with fellow researchers in other countries, engaging in collaborative projects (for example, within the EC Framework Programme), working at international laboratories (such as CERN, Geneva), attending international scientific conferences, etc. The extensive network of contacts thereby established—and constantly refreshed—encompasses many overseas organisations in government, industry and the charitable sector. A common outcome is that individual academics are approached to undertake commissioned research projects at the College. Academics also approach potential overseas sponsors of research by responding to

public invitations to apply for support from overseas charities, particularly American ones. They also solicit support from overseas governmental bodies which mount co-operative international programmes in research, eg USA and Japan.

The College centrally mounts no major promotional efforts abroad to enhance its portfolio of research projects. It relies rather on the above network of contacts to sustain the present level of research support from overseas. The network is strongest in Europe, followed by the USA and then the Far East, as reflected in the respective value of projects in the above table.

Recruitment of overseas students, including research students, is tackled more systematically through the College's International Office. This Office regularly sends representatives to student recruitment fairs in various parts of the world. (Some 38 per cent of research students presently at the College come from outside Europe. Strong links with Commonwealth countries, first established by Imperial College in the early years of this century, are still maintained today.)

4. *How does overseas investment affect your university's priorities or activities and those of individual departments?*

In general, very little. In one particular unit, our Interdisciplinary Research Centre for Semiconductor Materials has had the majority of its financial support provided by the Science and Engineering Research Council, but this has been augmented by significant funding from Japan Government Agencies and from Japanese industry. To compensate for this, the group concerned has made a determined effort to relate more closely to UK and EU activities, and as a result a number of important collaborative projects are being undertaken.

5. *Who are your competitors in attracting overseas investment? (other institutions, other countries)*

Where the research in question is very specialised, the only possible competition may be from a few other university groups, probably distributed across the world, working in the same niche scientific area. An astute sponsor will be aware of the track records of these groups and act accordingly.

Where the work is less specialised, the competition is likely to come from other universities of similar research standing, probably in the same country as the sponsor.

6. *What are overseas investors looking for? Why do they come here? What would constitute a "return" on their "investment"? Within what timeframe?*

In many instances the investor is looking for no more than a means of maintaining a watching brief in an advanced area of science or technology. If a UK university research group is working at the very forefront of a rapidly advancing area, a very efficient way for an industrial company to keep in touch with the very latest developments is to sponsor a post in the research group in question. The postholder would be expected to visit the overseas sponsor once or twice a year for discussions with the sponsor's own technical staff. Additionally the sponsor might offer to the university a research grant or contract, and in such circumstances it may seek rights to exploit commercially results arising from the research.

Sponsors come to the UK because of the world-leading research groups to be found here.

The attitude to "return" on "investment" differs greatly from one sponsor to another. In general it appears that overseas companies are prepared to support longer range research projects whereas UK companies tend to support only research nearer the market-place. A number of overseas organisations sponsoring research at Imperial College have indicated their willingness to support work which they judge is unlikely to produce results which can be turned into commercial products or processes within less than five to 10 years. It has to be said that in general UK companies concentrate their support on research with shorter term commercial potential.

7. *What benefits do you gain from overseas investment in your research? What benefits does the UK gain? (direct or indirect, short-term and long-term)*

As described in Section 1 above, about 10 per cent of the College's research income comes from overseas sources (excluding that from European Commission programmes). Without this support the College's portfolio of research would be 10 per cent smaller, for it is unlikely that the shortfall could be made up from UK sources. The College thus benefits from overseas support by having a more vigorous research programme, in both a scientific and a financial sense.

Because of the overseas sponsorship of research in its academic institutions, the UK is also likely to benefit, both indirectly and directly, from access to a large total research effort. Many of the research groups at Imperial College work simultaneously with a large number of sponsors, mainly from Europe but some from overseas. The general expertise and competence of a group largely depends on the range of different research problems it has tackled. The net result of the element of overseas support is that there are perhaps 10 per cent more trained researchers contributing to advancing the UK science base.

Since in general the type of research covered is by overseas organisations is not predominantly short range, there is rarely a worry that intellectual property of significant commercial value will therefore be made available to overseas organisations for commercial exploitation rather than UK ones.

8. *Is overseas investment concentrated in particular disciplinary areas? Which?*

Not markedly. In general the overseas investment in research at Imperial College follows much the same pattern as that supported by UK sources, but with some exceptions. For example, where the sponsor's host country is an industrial world leader in a particular technology, such as the UK pharmaceutical sector, this is likely to be reflected in above average support from that sector for university research. It does not follow however that funding will be concentrated necessarily in universities in the host country. Leading companies will scour the world in search of the best qualified research group with which to collaborate on its chosen range of problems. It appears that American healthcare companies recognise the research strength of UK medical schools, including that of Imperial College, and principally for this reason support much research in them.

As mentioned earlier, there is significant support from Japan for the work in advanced semiconductor materials at Imperial College. This reflects both the world standing of the group in question and the undoubted strength of the Japanese electronics industry.

9. *Are you aware of comparable investment by UK interests in academic science and technology overseas?*

It is well known that leading UK companies in the chemical, pharmaceutical and oil industries, amongst others, place contracts with overseas universities to gain access to particular academic expertise not available in the UK. The Sub-Committee will doubtless be taking evidence from companies in this category.

10. *How have these things changed over the last five years? How do you see them changing over the next five? What are the drivers of change?*

The annual Research Grants and Contracts income of Imperial College from overseas sources, including the European Commission, when expressed as a percentage of the total annual income from all sources of Research Grants and Contracts, has remained fairly constant over the last five years at between 15 per cent and 18 per cent. The same general pattern appears if European Commission contracts are excluded, the percentage figures for the last five years varying between 6 per cent and 10 per cent. There is therefore no indication of a significant rise in research commissioned from overseas sources. Neither is there any indication that the situation will change very significantly within the coming five years.

In spite of the world economic downturn of recent years, there has been no drop in Research Grants and Contracts income at Imperial College, neither in total nor in that from overseas sources. It has become noticeable within the last year that the enthusiasm of overseas organisations for placing new research contracts has diminished, and harder bargains are also being struck. Of particular prominence is the reduced activity of many Japanese companies in contacting UK universities with a view to collaboration in research. The situation is expected to change when the anticipated pickup in the Japanese economy takes place.

UK industry has cut back significantly on long range in-house research and in consequence must rely more on that performed externally. This coupled with the ever increasing complexity and interdisciplinary nature of research puts UK universities in a strong position to attract increased work from UK industry as economic conditions improve. This must be encouraged if industry is to derive proper benefit from the public investment in UK academic institutions.

One driver of change is the increasingly multi-disciplinary nature of the industrial design, development and manufacturing techniques which will be associated with many future commercial products. Furthermore the impact on the service sector of new technology should not be overlooked. For example, an airline with a passenger seat allocation and pricing system using the most advanced planning computer software is likely to have a market edge on its competitors. Universities will increasingly have things to offer the service industries.

11. *What happens to intellectual property rights (IPR) arising out of research conducted by your departments but funded by overseas interests? Is this any different from the IPR position regarding research funded by UK industry?*

Each research contract accepted by Imperial College, whether from an overseas or home sponsor, is negotiated separately. The approach taken by the College on intellectual property is always to argue to retain rights wherever such an arrangement can be negotiated, but offering the sponsor a non-exclusive licence on terms to be agreed which recognise the size of the financial contribution made by the sponsor. Experience in dealing with overseas companies indicates that usually they are more relaxed than UK firms about accepting such terms.

If the sponsor argues that an exclusive licence is absolutely essential, the College's reply will be that it would rather not concede on this point. If ultimately this is the only way under which research funding can be

attracted in the area in question, the sponsor will be asked to agree to pay a higher price than if only a non-exclusive licence were offered. Surrender of intellectual property thus has a price tag. It has to be said, however, that negotiations of contract clauses dealing with intellectual property can sometimes present substantial difficulties.

12. *What is the extent of your involvement with "Science Parks" and what do you see as being their aims and objectives?*

Imperial College, being sited in Central London, has no prospect of establishing a nearby Science Park. The College is however associated with two Science Parks, one at Silwood Park, Ascot, established some five years ago, now fully let, and a more recent and much larger one, Imperial Park, near Newport, Gwent. The latter is a joint venture with the Welsh Development Agency and Newport Borough Council.

In both these Science Parks, the College owns buildings which it rents out to technology companies, some spin-off companies from the College. This generates a useful level of net income for the College. Ideally the College would wish to see, based on the Science Park, companies with which it could collaborate on research or for which it could provide professional development courses.

It is well known that major inward investment has taken place in Wales in recent years resulting in the establishment of a number of manufacturing and assembly plants associated with overseas hi-tech industries from the USA, mainland Europe and Japan. Some of these companies are already extending the range of their activities to cover design and R&D. The Welsh Development Agency and the College are collaborating in a number of activities which aim to encourage the other companies to do the same and preferably to base their activities on Imperial Park. If and when this happens, the prospect of interaction, to mutual benefit, will be opened between company scientific staff based at Imperial Park and research groups at the College.

Memorandum by Oxford University

1. *Please describe the extent and manner of overseas investment in your departments concerned with science and technology. We are interested both in research and in post-graduate students.*

It is hoped that the extent and manner of overseas investment in science and technology at the University will be apparent from the data in the attached appendices. Appendix I gives an overview of research income from external sources over the past five years. This information is categorised in Appendix II (not printed), which provides a complete list of sponsors by name, country, sector and level of funds, including an indication as to whether the research was related to defence. It is difficult to define the term "overseas" precisely since some UK-based companies are subsidiaries of larger companies based overseas, and others are international in the sense that manufacturing, marketing and sales are carried out in a number of different countries. A further complication is the extent to which it is appropriate to regard other parts of Europe as overseas, since Britain is part of the European Community. Appendix III, therefore, attempts to give a picture of the income received from those companies which might generally be regarded as international. (Appendix III also gives an overview of defence-related research.) Appendix IV deals specifically with European funding and lists European sponsors by sector and level of sponsorship and Appendix V gives numbers of postgraduate students, their country of origin, and subject of study.

The Sub-committee might be interested to learn that since March 1989 the University has been awarded 70 long-term Fellowships from the European Commission (each of a duration between 6-36 months). In addition, 28 short-term Fellowships each of 3 months' duration, were completed in 1993. The Fellows are nationals of a range of countries including the following: Albania, Argentina, Austria, Belgium, Brazil, the former Czechoslovakia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, India, Italy, Lithuania, Netherlands, Poland, Romania and Spain.

The attached data show that by far the most substantial overseas investment has been for research in the medical/pharmaceutical area. The University has been most fortunate in obtaining major long-term funding commitments from pharmaceutical companies based in the United States. These close links are exemplified by two particularly beneficial relationships, with Bristol-Myers Squibb and G. D. Searle respectively, which are described below.

Bristol-Myers Squibb

In 1987, negotiations with Squibb resulted in a grant from the company to the University totalling £20 million over seven years. Of these funds, £6·4 million was used to build a new Department of Pharmacology, £3·2 million was allocated to the operating costs of the building, and the remaining £10·4 million funded various research projects. The terms of the agreement between the University and the company required the scientific personnel of the Department of Pharmacology to formulate proposals for research projects in five designated areas which were of keen interest to the company. Although Squibb was able to contribute to the overall definition of the research programme, the project proposals were initiated by the department, and Squibb did not control or direct the research. In return for its support, Squibb obtained exclusive rights to the results of the research projects which it elected to fund from those proposed by the department.

The degree of goodwill evident on both sides enabled the discussions to proceed without any serious delay. The experience of Squibb's senior management in negotiating with universities in the USA was also undoubtedly an important factor in the company's understanding of the attitudes of universities in the UK.

As is customary in academic-industrial collaboration, Squibb was given the right to request that a delay of six months be imposed on publication so that a patent application could be submitted. However, nothing in the agreement between the University and the company prevented the department from continuing to receive grants from the research councils or restricted its activities in any field other than the five main research areas. The University will receive a share of any royalties that arise from the commercial exploitation of results.

G. D. Searle

An agreement completed in 1984 between the University and Monsanto Company gave Monsanto's pharmaceutical subsidiary, G. D. Searle, access to relevant results arising out of a research programme in the field of oligosaccharides, led by Professor R. A. Dwek of the Department of Biochemistry. All of the results of the Monsanto-sponsored programme were reported to Monsanto, which then had the option of passing the results to Searle for further research and development. Over the course of several years, a close relationship has developed between Searle and the University and until recently this has taken the form of an arrangement which has allowed up to two Searle employees to work in the Glycobiology Unit in support of the main research programme and to receive training in specific research techniques. The research was so successful that Searle demonstrated its long-term commitment to the Glycobiology Unit by contributing £3 million towards a new building, now known as the Glycobiology Institute.

Another development related to Professor Dwek's research on oligosaccharides and which is worthy of comment illustrates how overseas investment can lead to the formation of new companies in the UK. As has been noted above, under the terms of the research agreement between the University and Monsanto, all intellectual property is assigned to the company in return for royalties. Since the programme covered a wide-ranging field, Monsanto did not necessarily wish to exploit every item of technology arising from the research, and therefore in some cases it was seen to be appropriate for Monsanto's subsidiary, Searle, to take over further development of certain aspects of the research. Notwithstanding Searle's involvement in the commercial exploitation of arising technology, however, there existed a mutual recognition that scope still remained for greater commercialisation of the full range of intellectual property, and this realisation led eventually to the establishment in 1987 of Oxford GlycoSystems Limited. The company was funded by Advent Limited and other venture capitalists, and the University and Monsanto took a share of the equity, as did Professor Dwek. (Now a flourishing company, Oxford GlycoSystems Limited is located very near to Oxford, on the Abingdon Business Park.) The University has since entered into a Technology Agreement with Oxford GlycoSystems which permits the company to train staff in the laboratories of the University, and to acquire intellectual property and know-how which is relevant to its business.

There is no simple explanation for the way in which research partnerships, such as those described above, develop between universities and pharmaceutical companies but several factors are relevant:

- Research is crucial to the identification and development of new drugs. Innovative products are increasingly important to the pharmaceutical industry as registration times cut effective patent life and government cost-cutting measures encourage the use of generic products once patents have expired.
- Mutually beneficial links have existed for a long time between university research groups and the pharmaceutical industry, and the successes of the past tend to encourage companies to seek further collaboration with universities. This has been especially true of Oxford, most notably in regard to antibiotics. (The therapeutic development of penicillin and work carried out at Oxford on cephalosporin are inspiring examples of successful collaboration.)
- The pharmaceutical industry appreciates the importance of basic, long-term research. Drug companies have always been forced to take a long-term view of product development, and this has its benefits for university research. Since the path from early research to marketable product can be tortuous and expensive for the pharmaceutical industry, its interests lie not so much in funding the type of opportunities which arise from the type of goal-specific, short-term projects which might be appropriate in other fields of research, but more in seeking the cost-effective, competitive advantages that can come about as a result of making a long-term financial commitment to a leading research group. Providing the company has chosen the right group, a considerable enhancement of the company's research capability is possible at costs which are relatively modest in industrial terms.
- Cuts in Government funding have forced universities to seek funding from external sponsors and to take the initiative in exploring the possibilities for collaboration with industry. Science departments are coming under increasing pressure to meet the spiralling costs of research (especially for high-tech equipment), and researchers are therefore looking beyond the traditional sources of funding to find means of obtaining new equipment so that they are able to retain their "cutting edge".

— The increase in collaborative research with industry has placed a new emphasis on applied and commercially useful research in universities, thus making these research bases more attractive to industry. Oxford's Medical Engineering Unit and Orthopaedic Engineering Centre, for example, have given rise to a number of successful products in the field of medical instrumentation; a glucose sensor based on research carried out in the Inorganic Chemistry Laboratory has been marketed profitably, and a company has been set up to market a non-invasive drug delivery system. The new company, Oxford BioSciences Limited, is located on the Oxford Science Park.

— Industrial managers are realising increasingly that certain activities benefit from being carried out in particular environments. University departments often lack the constraints of large organisations and are therefore seen to provide a more favourable atmosphere for innovative research. (Many small biotechnology companies, in fact, arose from university departments.)

— New techniques—especially in biotechnology—progress rapidly and commercial applications are often found shortly after their discovery. Industry can benefit from seconding personnel to university departments where they can gain valuable experience and training with their academic counterparts.

A competitive industry, in which research is the essential prerequisite for the development of new products, and a flexible approach from universities foster adaptable and creative forms of collaboration. As science becomes more and more sophisticated, interdisciplinary solutions to problems are likely to develop. The imaginative policies adopted by companies in the pharmaceutical sector have set in place a framework for a successful future in partnership with researchers in higher education.

It is a relatively simple matter to identify direct overseas investment in the University's scientific research but there are examples of "indirect investment", that is, where UK-funded projects rely on wider overseas investment to make them worthwhile. One such example involves the space agencies NASA in the USA and ESA in Europe: in this case the University's Department of Physics provides sensors for spacecraft in return for the use of the agencies' facilities, without which the research of the department would be severely restricted. In fact, virtually all research in the area of physics operates internationally, notably in co-operation with the rest of Europe through CERN and similar installations. The use of these large-scale facilities (to which this country makes a financial contribution) and the contact with other physicists leads to a sharing of know-how and expertise which undoubtedly has a beneficial impact on British science.

2. *We gather that Oxford University has developed a particular series of relationships with Japan. Please tell us what these are, and how they arose.*

The University has benefitted from the presence of Japanese students in Oxford for over 100 years, and indeed since the 1920s when his Imperial Highness Prince Chichibu studied at Oxford, the University has enjoyed close links with the Japanese Imperial Family. There are about seventy students from Japan currently in Oxford, of whom half are studying for undergraduate degrees in a wide range of subjects, including Biochemistry, English Literature, Management and Physics.

The Nissan Institute of Japanese Studies was formally opened in September 1981, following the granting of a generous benefaction by the Nissan Motor Co. Limited. The founding of the Nissan Institute has opened the way to an expansion of modern Japanese studies on a scale which might have seemed incredible only a few years earlier. The Institute's programme focuses on modern Japanese studies, and also aims to increase the awareness and study of Japan in other faculties. The Institute offers lectures in modern Japanese history, politics and economics, and holds weekly seminars, open to members of the University and the general public, on matters relating to Japan generally.

The University's decision to open an office in Tokyo has contributed much to strengthening the University's links with Japan. Several colleges have also established links with Japanese companies, amongst them Hertford, Pembroke and St. Peter's, which have each received benefactions from Tokyo Electric Power Company. These three colleges have also received donations from Kajima Construction Company, Shimizu Construction Company and Hitachi, respectively. Keble College has received support from the Industrial Bank of Japan.

Companies which have supported a post, provided the finance for a building or scholarships for students have their names associated with Oxford and build up a permanent link of friendship with the University.

In view of Oxford's reputation for research, it is perhaps surprising that there have been relatively few research contracts or other forms of research collaboration with Japanese companies. As a means of addressing this perceived lack of Japanese industrial interest in the University's research resources, the University has appointed TechnoVenture, a firm of venture capitalists, to assist in promoting the University's research in Japan. In return for an annual retainer, TechnoVenture seeks funds from the Japanese pharmaceutical industry for research in two specific areas. The Agreement with TechnoVenture requires the University to pay a small percentage of any funds secured to TechnoVenture if the company is successful in attracting Japanese industrial sponsorship.

3. *Do you actively seek overseas investment? How? From which countries?*

The University is actively seeking benefactions from overseas sources as part of its fund-raising campaign, as is demonstrated by the work of its University staff in New York and Tokyo and by the investment which the University has made in establishing offices in these locations.

Oxford is recognised as a world-class university and it works hard to maintain its international reputation as a centre of excellence. As members of the University, particularly those working in scientific and medical research, see themselves as part of an international community, a natural framework for informal approaches to overseas investors has developed.

Funds for science are scarce in the UK, and the University promotes its research internationally on a formal level by means of public relations material, events, and organised lecture tours by leading academics. Individual academics are encouraged to maintain strong informal links with individuals and organisations overseas.

Funds for science are sought primarily from the United States, although efforts are also being made in Japan. It will be seen from Appendix IV that £2.2 million of the £3.2 million which the University receives from European sponsors comes from the European Commission. However, as this country contributes to the funding which the Commission allocates to research programmes, the Committee may feel that EC funding should not be termed "overseas investment".

4. *How does overseas investment affect your university's priorities or activities and those of individual departments?*

Large financial commitments, such as the £20 million secured from Bristol-Myers Squibb, transform the department in which these funds are invested. There is no doubt that close links with industry encourage greater awareness in the academic community of the problems currently facing industry and that they foster an interest amongst researchers in finding solutions. This curiosity-led drive amongst senior academics inevitably has an impact on the development of undergraduate courses which in turn become more relevant to questions of global technological significance.

In the case of relatively small sums of money, the actual source of funds is of lesser importance to individual departments since this support is merely to cover the actual costs of carrying out the work and does not make a fundamental difference to the recipient departments.

5. *Who are your competitors in attracting overseas investment? (other institutions, other countries)*

The committee may be aware of the very large development at University College, London funded by the Japanese company, Eisai. Oxford was unsuccessful in attracting Eisai because the work at UCL was of more direct relevance to Eisai's commercial objectives. Generally, the University is in competition with the other best research universities in the UK. We are not aware of fierce competition for research funds from other countries, except in regard to science parks (see 12).

6. *What are overseas investors looking for? Why do they come here? What would constitute a "return" on their "investment"? Within what timeframe?*

Overseas investors look for quality and price (staff costs in UK universities, for example, are much cheaper than in the United States), but a substantial factor in bringing overseas interest to the United Kingdom is undoubtedly the fact that the language of the international community is English. Overseas investors are also attracted to UK universities by the following:

- a sophisticated approach to the protection of intellectual property. British universities are well aware of the potential commercial value of intellectual property and the need to maintain confidentiality prior to patenting;
- the patent system in the UK. This system makes it impossible to file a valid patent application if publication/disclosure has taken place. It may be a plus factor, psychologically at least, that overseas companies know that universities in this country are used to accepting delays on publication until a patent is filed;
- the active encouragement in this country of close links between industry and universities.

The "return" on investment might be said to consist of the following:

- potential recruits from academia to the workforce;
- access to first-class training for industrial employees in the University's laboratories;
- the quality and prestige of an association with Oxford University as an institution of international renown;
- access to valuable intellectual property (the timeframe varies depending on the nature of the work—a new drug can take 10 years).

7. *What benefits do you gain from overseas investment in your university? What benefits does the UK gain?*

The University gains:

— financial sponsorship, and therefore the ability to carry out as much research as we can, within existing constraints on accommodation;

— the means by which it can maintain its reputation for world-class research (see question 1);

— a much clearer view of the techniques in innovation employed by foreign companies. This is helpful both in terms of negotiating research contracts with British industry and in helping researchers to ensure that their work has real value in an international context.

The UK gains:

— additional financial support for one of its leading universities as a world-renowned centre of scientific excellence;

— the continuation of high-quality research and teaching which has benefits for British industry in terms of recruitment and access to results. Services to industry which would not be possible without the more mainstream research projects can be accessed by SMEs.

8. *Is overseas investment concentrated in particular disciplinary areas? Which?*

Yes. Biological research which has medical implications.

9. *Are you aware of comparable investment by UK interests in academic science and technology overseas?*

The pharmaceutical companies, Glaxo and SmithKline-Beecham, both have laboratories overseas, notably in northern Italy. The pharmaceutical industry regards its sources of research expertise as being world-wide.

10. *How have these things changed over the last five years? How do you see them changing over the next five? What are the drivers of change?*

The recession has seen a reduction in the interest shown by overseas companies in funding research at Oxford. Last year, for example, both Bristol-Myers Squibb and Monsanto Company negotiated a reduction in their support for science at the University. As the pharmaceutical industry continues to require access to first-class research in order to survive, it is expected that the expansion of clinical and pre-clinical research at Oxford, enabled by a major grant from the Wellcome Trust and the appointment of new professors, will lead to further large-scale, long-term collaborations between the medical departments and the pharmaceutical industry (although such collaborations would have to be co-ordinated carefully with the Wellcome Trust in some instances).

The drivers of change are: (1) levels of income and expenditure; (2) Government policy; and (3) national and international issues.

An example of how a growing international and national concern for a certain issue has had an impact on the University's research has been the increasing awareness of the need to protect the environment. In 1991 the University set up an Environmental Change Unit with the aid of funds from a variety of sources including IBM, PowerGen, Lloyds Bank, The Loke Wan Tho Memorial Foundation, The Dulverton Trust and The John S. Cohen Foundation. The unit is interdisciplinary and dedicates itself to research on the nature, causes and impacts of environmental change. The Environmental Change Unit has been particularly successful in attracting funding from the European Commission.

11. *What happens to intellectual property rights arising out of research conducted by your departments but funded by overseas interests? Is this any different from the IPR position regarding research funded by UK industry?*

The University normally seeks to retain ownership of intellectual property and to grant a sole licence to the sponsoring company in return for royalties. However, the pharmaceutical industry in particular believes that it is essential for the companies to own any arising intellectual property and the University has been prepared to compromise in the majority of its contracts with major pharmaceutical companies, subject to a reasonable return in the form of royalties. The question of ownership of intellectual property is inextricably linked to the level of funding.

On the whole, British universities sell their research cheaply, usually seeking only to recover the direct costs of the projects and a modest contribution to indirect costs (overheads). This University will often elect to carry out research on this basis, that is, to share the costs of a research project, if it is work which the University wishes to do.

Money, however, is not the only issue here: "foreground" intellectual property arising from a project becomes "background" to a later project which builds upon the earlier results. In many cases the exploitation of this "foreground" also requires access for commercial purposes to the "background". If the "background" has been assigned by the University to a third party, perhaps to a marketplace competitor of the company

interested in supporting the later project, access is likely to be denied. As an increasing amount of research is carried out in collaboration with industry this is becoming a serious problem. The end result, if assignment of "mainstream" intellectual property is made, will be that the University has lost some freedom of action, which is potentially damaging to future research programmes. The University attempts therefore, wherever possible, to retain the intellectual property under its own control. Researchers will then be free to build upon it in later collaborations with other partners.

The University does not distinguish between British and overseas companies. We negotiate the best deal we can, regardless of the funding source.

The real problem is not the intellectual property which arises out of research funded by companies (as this is subject to a fully-negotiated research contract) but intellectual property arising out research funded by charities and other bodies, where the question of who owns the intellectual property rights is vague. In some cases individual researchers fail to notify the University of valuable intellectual property arising out of such work, and exploit it themselves; this carries the risk of the intellectual property being suppressed, or being licensed to an overseas company without a British company being given the opportunity to acquire a licence.

It is the University's policy to encourage and facilitate research collaboration with industry, and to promote the successful transfer and exploitation of its intellectual property. In the organisational structuring of its research support and technology transfer activities, Oxford has taken a two-pronged approach to ensure that companies are provided adequate introductions to the University's research resources and that industry is made aware of technological developments of potential interest. This approach combines the work of the University's Research Services Office and the wholly owned subsidiary company, Isis Innovation Limited. Isis Innovation Limited was formed in 1988 to exploit results arising out of research funded by the five research councils and those funded by other bodies which are not subject to an agreement with the University whereby the rights have to be assigned to the grantor. If a researcher does not wish to exploit his or her intellectual property through Isis Innovation, the University does not withhold permission to exploit by an alternative route as long as it is clear that the technology in question will be exploited effectively and that the University will receive a reasonable financial return in due course.

12. *What is the extent of your involvement with "Science Parks" and what do you see as being their aims and objectives?*

The University does not have a science park, although Magdalen College has developed one in partnership with the Prudential: The Oxford Science Park. The University maintains links with this science park through the Research Services Office. The Director of Research Services Office sometimes assists the science park by meeting potential tenants to point out the advantages of being located close to the University's science departments. One or two such companies which ultimately decided not to re-locate to Oxford elected to go elsewhere in Europe, and France is often cited as an excellent source of professionally-run science parks.

The University has links with most of the science and business parks in the area, since companies which have been formed to develop and market results arising out of University research are often situated on such parks. In addition to Oxford GlycoSystems Limited which has already been mentioned, the University has in the recent past negotiated an agreement with the owners of the Milton Business Park (Lansdowne Estates) to set up Oxford Asymmetry Limited, which has recently won a SMART Award and has premises at Milton Park. The University's policy is to support science parks generally, as it would clearly be to the University's benefit if a major company chose to re-locate its research laboratories to a science park in the Oxford area.

Strong links exist between the University and The Oxford Trust, a charity set up by Sir Martin Wood, to encourage the development of science and technology in Oxfordshire. Small "start-up" premises are provided at cheap rents by the Oxford Trust at its S.T.E.P. Centre in central Oxford (S.T.E.P.—Science and Technology Enterprise Project).

June Clark

18 February 1994

APPENDIX I

Research Income from External Sources

Sector		*Number of Sponsors*	*1989 £K*	*1990 £K*	*1991 £K*	*1992 £K*	*1993 £K*
Charities—Medical	Overseas	10	240	349	410	551	671
	UK	51	7,594	9,296	11,239	13,979	16,411
Charities—Other	Overseas	11	218	269	544	311	266
	UK	17	540	738	759	976	803
Industry—Engineering/	Overseas	10	78	97	135	232	312
General	UK	29	1,252	1,404	1,579	1,574	1,512
Industry—Pharmaceuticals/	Overseas	45	10,379	3,811	6,456	7,948	6,265
Medical	UK	22	1,236	2,865	2,977	1,531	1,724
Industry—Telecoms/	Overseas	3	53	78	120	186	166
Electronics	UK	14	160	173	235	448	1,117
Learned Societies	Overseas	3	0	13	63	31	15
	UK	8	1,393	1,532	1,731	1,826	2,280
Publicly Funded	Overseas[1]	27	1,385	3,190	2,115	2,574	2,962
	UK	50	22,102	23,657	27,648	29,481	37,936
TOTAL	Overseas	109	12,353	7,807	9,843	11,833	10,657
	UK	191	34,277	39,665	46,258	49,815	61,783
Other Bodies[2]		—	957	1,089	1,093	913	755

[1] Includes the European Commission.

[2] Includes amounts under £10,000.

APPENDIX III

Research Grant Income

A. *Income from International Companies*

Research income was received from 41 "global" companies of which 18 have their main base in the UK. Income from these companies over the period 1989–93 amounted to the following:

£K	*1989*	*1990*	*1991*	*1992*	*1993*
Total	11,685	6,571	9,715	9,440	7,420
Of which UK based companies	1,541	3,723	3,527	2,030	1,982

B. *Defence Related Research*

Income for research was received from 11 defence related companies or agencies over the period 1989–93. Of these, seven were UK based.

£K	*1989*	*1990*	*1991*	*1992*	*1993*
Total	1,086	1,229	1,245	1,640	1,741
Of which UK based organisations	965	1,057	1,126	1,530	1,624

APPENDIX IV

Research Grants: European Sponsors

Sector	*No.*	*1989 £K*	*1990 £K*	*1991 £K*	*1992 £K*	*1993 £K*
Charity—Medical	2	17	0	0	25	0
Charity—Other	2	48	30	19	20	12
Industry—Engineering/General	3	22	37	0	17	36
Industry—Pharmaceuticals/Medical	17	289	588	423	597	762
Industry—Telecoms/Electronics	1	0	0	14	0	11
Learned Societies	3	0	13	63	31	15
Public—European Commission	1	429	1,397	1,571	2,016	2,232
Public—Other	6	83	83	49	142	196
Total	35	888	2,148	2,139	2,848	3,264

Note: Includes non-EC countries which are members of the European Economic Area.

APPENDIX V

Post-Graduate Students in Residence 1993–94

Overseas Post-Graduate Students (excluding European Union Countries) **Total 459**

Biological Sciences	
Biochemistry	46
Plant Sciences	14
Zoology	26
Mathematics (including Computation)	78
Medical Sciences	
Clinical Medicine	42
Anatomy	6
Pathology	10
Pharmacology	9
Physiology	17
Psychology	17
Physical Sciences	
Chemistry	38
Engineering	77
Physics	39
Materials	33
Geology	7

European Union Countries		**Total 169**
Biological Sciences		
Biochemistry	15	
Plant Sciences	8	
Zoology	13	
Mathematics (including Computation)	48	
Medical Sciences		
Clinical Medicine	12	
Anatomy	1	
Pathology	4	
Pharmacology	4	
Physiology	10	
Psychology	4	
Physical Sciences		
Chemistry	11	
Engineering	13	
Physics	19	
Materials	4	
Geology	3	

Examination of witnesses

DR DAVID THOMAS, Pro Rector (Research Contracts), PROFESSOR IGOR ALEKSANDER, Head of the Department of Electrical and Electronic Engineering, and PROFESSOR HOWARD THOMAS, Head of the Department of Medicine at St Mary's Hospital Medical School, Imperial College of Science, Technology and Medicine, and DR PETER NORTH, CBE, QC, Vice-Chancellor, and MRS JUNE CLARK, Director of the Research Services Office, Oxford University, were called in and examined.

Chairman

1. I welcome you. I would simply like to begin by reminding you that we are setting out to obtain evidence about international investment in UK science, by which we mean overseas investment in research, in science, engineering or medicine carried on in the United Kingdom, whether for civil or defence purposes. We are interested in investment from overseas sources, whether from the commercial or public sector and whether from within or outside the EC, including investment in any form, research units, either free-standing or associated with manufacturing plant, research contracts with universities, research councils, government research establishments and so on. Finally, we have had the privilege of seeing papers written for the purpose of the House of Commons Committee on Science and Technology, who have given us permission to see them because they are relevant to our enquiry, though they do not deal with all of it. These are papers written by Sir Richard Southwood, as Vice-Chancellor of Oxford, and by Sir Eric Ash of Imperial. So we have seen the material in those papers. Would Dr North like to begin?

(*Dr North*) Yes, my Lord Chairman. All I would like to say is on a purely administrative matter. We in Oxford have prepared written responses to the listed questions with appendices of statistics which we thought might be useful to you and your colleagues. The Clerk has them in front of him. We thought we would bring those and leave them with you.

2. We shall have an opportunity of studying those with pleasure and interest. We are grateful to you for going to that degree of trouble.

(*Dr David Thomas*) Our document is with the Clerk. We have done the same.

3. Turning to Oxford first, you have developed a particular series of relationships with Japan, we understand. I wonder what you would like to say about those and how the Japanese approach this question.

(*Dr North*) The university has had links with Japan for a hundred years or more. We have some 70 students from Japan at the moment, some undergraduate, some graduate. Some of our links with Japan have a higher profile beyond the ranges of science and technology. The Crown Prince and his wife both studied here. That highlights the focus on Japan. I suppose the major investment that we have had from Japan to the university in recent years is the Nissan Institute of Japanese Studies. The purpose of that is the study of modern Japanese affairs which is really removed from the remit of this Committee because we are looking there at modern Japanese history, politics, economics and the like. That, in a sense, has heightened the focus on work in Japan. We do have, as part of our development office, a university office in Tokyo, just as the university has an office in New York. That is there to engender links of a whole variety of kinds with Japan. Individual colleges have Japanese links which have led to support from commercial and financial bodies in Japan. What we do not have a great deal of are links with Japan in what I would call the research contract field, the scientific research contract field. In a sense, it is quite striking that we do not. I am not sure we are typical in that respect. What we have done is appoint a form of venture capitalist in Japan, called TechnoVenture, to assist in promoting our links and activities in Japan. That has been running for about a year. I think it is fair to say it had a relatively slow start. It is geared very substantially to promoting links with the pharmaceutical industry. I think it is

[Chairman *contd.*]

fair to say that links with the pharmaceutical/biomedical industry overall are the areas where Oxford can see the largest amount of overseas investment and Japan is where we are trying to pursue the same activity. I think it is fair to say we are fairly active but not particularly successful.

Lord Porter of Luddenham

4. Are we going to be able to have the total statistics over and above the ones which you gave to the House of Commons? Those statistics were, I believe, about entirely overseas support from overseas industry and did not include governments and so forth, nor indeed the European Community.

(*Dr North*) Again, if it is helpful, the appendix we have got on research from external sources is broken down into charities, industry of three kinds, learned societies and public funds, which includes government funds, and the European Commission, split between the United Kingdom and overseas, so that you can see a balance between the two.

5. It would be interesting if you could tell us what the overall figure is because your overall figure was £7million for research grants and contracts from overseas industry. That is the only paper we have had so far. Presumably, what you are going to tell us now, Dr North, is a much larger figure?

(*Dr North*) Yes. The total external research income for Oxford in the year 1993 is £72 million, of which £10/£10.5 million is from overseas and of which the most striking figure is something over £6 million from the pharmaceutical/medical industry.

Chairman

6. May we hear from Imperial?

(*Dr David Thomas*) Over the last four years the average value of grants and contracts accepted, has been roughly £45 million per year. Of that, some 18 per cent by value comes from overseas. That breaks down to 9 per cent from the European Commission, which is the biggest overseas contributor. Looking at individual countries, 3 per cent comes from the USA, 2 per cent from Japan, 1.5 per cent from non-European Union Europe, and 0.7 per cent from the European Union countries, excluding the EEC. This second 9 per cent of our income comes under three headings: industry which is the biggest at 4.5 per cent, government agencies at 3.4 per cent; overseas charities at 1.1 per cent. These figures are in our paper.

7. Dr North, from the original paper which went to the House of Commons—and we have not had an opportunity of reading the new one—we learnt of a number of investments from overseas industry, particularly pharmaceuticals, with Oxford GlycoSystems Limited, Professor Dwek and a number of others. I take it from what you said that you, as the university, are now going out positively to seek such overseas investment. Did those come as a direct initiative from the university or were they initiatives which came from companies to you in the first instance?

(*Mrs Clark*) In each case they were initiatives of the individual scientist concerned, with the support of the university. They were not university initiatives but they were most definitely the initiative of the individual scientist concerned.

8. Has that been most usual, that a scientist has approached an overseas company to come to the university and said, "Look, we are thinking about this particular process" and it has been taken from there?

(*Mrs Clark*) There are different forms of making an approach. I believe you are going to visit the Department of Pharmacology at some point. You will hear more about Bristol-Myers Squibb giving the university £20 million. Professor David Smith held a series of workshops in the department and invited representatives of various pharmaceutical companies to attend. At the end of the day the only response we had was from Glaxo, I believe for a relatively small sum of money. Then some weeks later the representative from Bristol-Myers Squibb, who had been there (it was then, of course Squibb not Bristol-Myers Squibb) invited Professor Smith to put in a much larger bid.

(*Dr North*) Could I add one clause on that? I think, so far as university initiative is concerned on this, it is quite difficult to separate out the generation or the attraction of research funding from benefaction funding. Oxford University has been very active in the last five years in fund raising world-wide and negotiations with industrial companies may lead to research being supported or may lead to endowment. You are never quite sure which it is going to be. I think in areas of recession it may often be more comfortable for companies to support research than it is to support endowment. There is a lot of initiative going on but you are not quite sure in what form it is going to come back.

9. Would the same principles apply probably to Imperial?

(*Dr David Thomas*) Yes. May I confirm that the sales force, as it were, comprises the individual academics who make contacts round the world with people in similar groups. In some cases the college will be approached directly by a company saying, "We would like to work with such and such a department and Professor So and So".

Lord Nelson of Stafford

10. This is very important to our enquiry. We want to arrive at some measure of value of the relationships to the country and companies concerned. I can well understand that initiatives in many instances will come from individual studies. What I would like to be clearer on is how and why those arise. Do they arise because support from overseas enhances the work of the individual or do they think there is an opportunity to exploit their work which they would not have here? I think, looking at it from the other point of view, the question is: Why does it occur in certain industries, of which pharmaceuticals seems to stand out, and not in other industries, for instance electronics, which I would have thought was a pretty lively industry? Are we missing out on opportunities where we should be doing more exchange of technology as distinct from those areas where we are doing it? Who should the initiative rest with? Should it rest with companies to

[Lord Nelson of Stafford *contd.*]

come out and say, "Why do we not do more of this together?" or does it rest, as you say, with the individual scientists, or does it rest even with the university itself or the department in the university?

(*Professor Aleksander*) You spoke of electronics, with which I am familiar. In fact, our major endowments were in the electronics area. They do not seem to carry the same price tag or as large a price tag as some other areas but they are very effective nonetheless in a department like mine. The investment in posts from overseas companies can make all the difference between solvency and penury. To go back to the earlier part of your question, they are done on the basis of mutual trust which takes a very long time to develop between major research organisations overseas—and Japan comes to mind—and the amount by which researchers in departments are known to those organisations. The trust needs to be built up. Once it has been built up, it is very effective.

Chairman

11. With the exception of the pharmaceutical industry which, of course, has continued in this country to be very prosperous, is it a perception among academics that it is more likely that they will obtain substantial funds by approaching overseas companies rather than UK-based companies nowadays?

(*Professor Howard Thomas*) I can quote from the experience I have had, which has been mainly with biotechnology companies and the pharmaceutical industry. In general grants for basic research as opposed to clinical trials, from overseas industry, are for three to five year timeframes, whereas the duration of project funded by British industry is of the order of one to two years, with a yearly review. There is a difference in the period of commitment from these two sources.

Lord Perry of Walton

12. You said that nearly all the money came from contact between the member of staff and the company overseas. Surely that does not apply to the endowments?

(*Dr North*) No, sir. I was trying to broaden the point, that if there is a department which is very keen to pursue research in a particular area—and the example that I was taking was the pharmacology Department at Oxford as it is a good example—a lot of the initiative will come from the head of department or the senior members of the department, focused very much on the provision of research funding for major projects within that department. The Chairman asked in a sense if the institution, the university as a whole, was active in seeking funds. The answer I tried to give was that, yes, the institution is active in seeking funds more broadly. It may focus particulary on endowment. What it may get are research funds which it would dearly like to have. You are never quite sure what the pay-off is going to be.

13. What I am trying to get at is what proportion of the total overseas investment is coming from the university initiative and what from the initiative of the individual members of staff?

(*Dr North*) I think I would need advice on that question. We can let you know that. I do not have the statistics at my fingertips.

14. Then an informed guess would be better than nothing?

(*Dr North*) With an informed guess a considerably higher proportion would come from the initiative of the individual scientist.

Chairman

15. I think it is likely, is it not, that in Oxford, following the formation of the Campaign for Oxford seeking funding positively, many of the endowments have come through the development office?

(*Dr North*) Yes.

16. Is there a comparable organisation at Imperial College which has been established purely to raise funding for the university as a whole?

(*Dr David Thomas*) We are very much in the early days. Our endowment income is very modest. There is a half-way house, of course, between contract research and charitable donations, this being sponsored posts which my colleague mentioned. We find such posts extremely valuable. There the pattern sometimes is that an individual academic will talk to a company; the college then discusses how the matter should be progressed and a suggestion will be made that an academic post should be sponsored by the company. That is a very good way of establishing a link. The company then will require the academic to visit the company premises once or twice a year for discussions. It does mean the college is free to employ the post-holder exactly as it sees fit doing the sort of research that person wishes.

Lord Desai

17. When individual scientists apply for this money, what incentives does the institution provide? What rewards does the scientist get, having done that? Does he get time off from teaching?

(*Mrs Clark*) It really depends on the nature of the collaboration. In the case of Bristol-Myers Squibb, obviously the incentive to Professor David Smith was a new building of pharmacology which offered tremendous expansion and potential. Depending on the nature of the collaboration, it is possible for academics to be relieved of teaching in order perhaps to work part-time in the company to develop some intellectual property which would then be to the benefit of the university and the individual academic and, of course, to the company concerned. We have done that at Oxford. It is not easy to achieve in all instances but when it is appropriate it has been done. I think probably the main incentive would be simply the opportunity to maintain large-scale, long-term research programmes. One of the advantages which my colleague at Imperial referred to was the long-term nature of some of the collaborations which overseas companies are prepared to contemplate. I think it is a feature of British industry that as yet we are not seeing the same tendency to enter into long-term arrangements.

Earl of Selborne

18. This is a theme which we have picked up on previous enquiries frequently. Indeed, it is frequently held to be the case that British industry cannot be persuaded to take a long-term view on research which by its nature is long term. Given the perspective that you have of receiving research grants from overseas companies over a longer term timescale than you are able to attract from United Kingdom industry, is there any lesson you feel that British industry can learn from this experience that you would like to say might be the reason for the short term approach by British industry?

(*Mrs Clark*) I think it would be a generalisation but my sense is that some of the overseas companies which we have collaborated with have not seen intellectual property or research as being necessarily the prime motivation. They wanted, for various reasons, to improve their own in-house technical expertise. They wanted to gain access to potential recruits and they wanted perhaps the opportunity to have some of their own scientists come to the university for a period of training. That has altered their perspective and approach to us. I think at the moment British industry tends to look at the collaboration purely in research terms. As yet, we have not seen such an emphasis on training opportunities and secondment from British industry or other bodies at Oxford.

(*Dr David Thomas*) We have noticed recently a tendency among a number of major British companies to shorten their horizons even further. They are down-sizing on staff. It seems that their research interests are now turned to very short term matters only. In discussions with a number of major British companies, we have found it very unsatisfactory in a national context that they are not supporting the sort of work that is to their own long-term benefit. They could easily do it through the universities. They do not have to do it in-house. Instead they approach universities asking them to do very short term work which is probably not appropriate.

(*Professor Aleksander*) I could make a departmental point which may be quite significant. A department such as mine, which is about a hundred years old, has a long-standing tradition of collaborating with the leading research laboratories in the United Kingdom in the area of electronics and electrical engineering. What has happened recently is that these laboratories and the standard of that sort of fundamental work has disappeared. Companies no longer maintain these laboratories with that sort of excellence. It seems natural then to look to where such laboratories may exists and they do exist in the United States and Japan. Therefore, some of these benefits that arise as a result of endowments and other forms of contact with what are now the world's leading laboratories are very useful in enhancing the quality of the work in the department.

Chairman

19. You are talking about contacts with the research laboratories in-house of individual companies?

(*Professor Aleksander*) Yes.

20. Does the university or IMPEL have any contacts directly with the Association of Independent Research and Technical Organisations? Are they in any way taking over some of the work that would previously have been done in-house? What do you feel about their role in this situation?

(*Professor Aleksander*) That has become internationalised as well because we have as much contact with overseas agencies of that kind as in the United Kingdom.

Lord Perry of Luddenham

21. Is the withdrawal of British industry from the maintenance of research laboratories in-house solely due to the recession or is there a change in philosophy about it?

(*Professor Aleksander*) It is longer term than the visible recession. It probably goes further back than the eighties. There was the beginning of a decline somewhere around the beginning of the seventies when trouble ahead was seen. I do not want to mention individual companies but if you look at the spread of fundamental research laboratories, you will notice a decline starting in the mid-seventies.

(*Dr North*) It is an increase of short-termism.

22. Could there be an explanation for that?

(*Dr David Thomas*) I could hazard one possible explanation and that is that a number of major companies, formerly with serious science and engineering interests, have now redefined their roles to become service providers, purchasing the necessary hardware from outside the United Kingdom in many cases.

Lord Nelson of Stafford

23. The question of incentive is extremely pertinent. I am very interested in what you said about that which applied to institutional heads of departments and foreign firms. I would like to be clear on the relationships between the university itself and British companies. The relationship between industry and British universities is better than it was. Maybe it has to go a good deal further yet. The question at the back of my mind is the degree to which the universities see they have a positive role to play in this as distinct to leaving it to individual departments or the organisations which were set up to handle it. Do the heads of the universities, vice-chancellors themselves, say, "Why are we not doing more of this?" or, "Why is this not happening? Why is something else not happening?" and so on.

(*Dr North*) Do the universities institutionally have an interest in the success of their science departments? The answer is an unqualified yes, both for intellectual and for financial reasons. For intellectual reasons, if you believe yourself to be a world class institution, you want scientifically to be at the front end of whatever scientific research your university is equipped to pursue. There is a very clear institutional concern but perhaps more pragmatically there is the fact that the funding of universities in this country, certainly in England through the English Funding Council, operates to a formula whereby the public funds which flow through the funding council to the university are to a large degree dependent on your research excellence. The institution is very concerned to see that funds are

[Lord Nelson of Stafford *contd.*]

available in science departments, as in all other departments, to maintain the excellence of the university and those departments at the front line of research. Your question was, if you like, directed to the heads of the institutions. I think we would all be failing in our duty to the institutions if we did not actively pursue that. It is, of course, difficult for the institution itself to know just which areas of scientific research should be pursued. I am not sure I could sit in my office as a lawyer and tell my scientific colleagues just what avenues they ought to be pursuing. What is important institutionally is that one establishes an environment where this is perceived to be what should be done and encouragement is given to do it. That is what we should do and in my view we do that.

Chairman

24. Do you wish to add a dimension from Imperial College?

(*Dr David Thomas*) I have responsbility for an industrial liaison office whose role is to promote research. This is proactive work; for example, we would invite a group of directors of a particular major company to come to the college for a day to be given presentations from a number of senior academics, the hope being that a synergy will arise between the interests of the company and the interests of the academics and that will follow through into a collaborative programme of some sort. That would be one way. Some major companies have university liaison officers. I am constantly in touch with them. I will invite them to the college; they will visit the college and speak with heads of departments. We do what we can, although the office is rather small. In reality, the main sales force in bringing in research must be the 600 academics, not the six people I have available to deploy. Nevertheless, we take a positive attitude. My Rector and I have certainly been trying to put a proactive dimension into this.

Lord Nelson of Stafford

25. Of course, some academics are better salesmen than others. That is one problem.

(*Dr David Thomas*) Indeed, but we do try to field those that are good salesmen and help those that are not.

Lord Butterfield

26. I think I would like to acknowledge for the record that in the civic universities local firms very often gave chairs. I am thinking particularly of Boots of Nottingham, of course. It is a sad reflection of the state of manufacturing industry, I suspect, in this country that they are apparently less able to do that kind of activity. The second thing I wanted to say is that we must not be surprised, or I am not surprised, that our people are going abroad to do science or have science connections because the equipment, certainly in Japanese laboratories, just leaves us standing. The equipment in our pharmaceutical laboratories makes our research in the pharmacology department look old-fashioned. My recent shock about this was when a Hong Kong student studying at a United Kingdom university left after one term because he said the equipment in the Engineering Department in question was antiquated and he was going to go and work in America where he would see apparatus that he would be using when he left the university. That is, of course, a sad reflection of all this business about harsh funding decisions which I know is part of a country which is in recession and in difficulties. My third point is really a question. I so much agree with the need to build up close working relations. I was busy before I retired trying to build up close relations in Japan. One of the difficulties, both at my level and I think at the university level, was how expensive it is to go to Japan and stay there and do this very important business of building up relations. We tried to get around it in one university in Tokyo by encouraging them to send research fellows to us. We could feed them much more cheaply than we could go to live with them in Japan. There is this business about academics being able to get around, particularly the salesmen academics, to sell the universities' wares now that science is international and you might as well be making your links in developing laboratories in different places. Is there any difficulty for the individuals or the departments or the universities in finding the funds to be able to give people an air ticket and a hotel voucher to go and do some salesmanship? I have a very strong feeling that as far as Japan is concerned we are poor and that is holding up our very important salesmen activities at academic level. I think companies are a little easier about sending people out if they can find the money. I think that is one of the difficulties for a university department, finding the money for people to travel.

(*Dr North*) I think the answer to Lord Butterfield must be yes. In a sense the example which he gave earlier of a department not as well equipped as he would like to have seen it or his student would like to have seen it exemplifies the problem. You can invest money in a number of things but you cannot invest money in everything. If you are going to have to buy a new piece of equipment for the department, you may not be able to invest in the air fares for somebody to pursue other research contracts. I am afraid that is a harsh fact of financial life.

27. Yes.

(*Professor Howard Thomas*) I would like to comment on meeting grounds, between industry and medicine. People from the pharmaceutical industry, of course, attend the international meetings and this is a very fruitful way of getting together. Of course, the first meeting is with scientists and you then have to get into the business component of the company which is the second stage. I have found the method of interaction with industry really very fruitful. The other way in which interaction is readily obtained, usually at the initiative of the universities, is by the creation of biotechnology companies: these start-up groups, recieve a lot of funds, of course, from the multinational pharmaceutical companies and also from venture capitalists. They then will look around for the best scientific contacts and a milieu is created in which the work is defined and then the best environment in which to compete is determined. That, I think, is something that we should look at.

[Lord Butterfield *contd.*]

We have not developed the biotechnology start-up companies quite so fruitfully as the Americans have done, particularly in California.

Chairman

28. One point that Lord Butterfield raised relates to an advantage that we have in medicine and that is the kind of endowments that come sometimes from our former patients. I certainly had the experience in my former university in Newcastle of a patient of mine who was head of a very large building firm and he eventually endowed some ten appointments over a period of years in the university. Even an American patient endowed another one. This is an advantage that medicine may have. It follows from that I would like to ask you all whether you feel that this kind of success in bringing very large outside funding for particular initiatives carries any risk of distorting the university's priorities in relation to their future plans for not just scientific development but overall development. Is that a risk?

(*Dr David Thomas*) My perception is it is far from being a risk. It is actually an advantage. This enables our scientists to do more research, to do longer range research and to do it in collaboration with world players of all sorts.

29. The reason I ask you this, being a devil's advocate, is because it is being said to us sometimes that it ends up meaning that the haves get more and the have nots get less. Is that something which you would deny?

(*Dr David Thomas*) The world is very competitive. The individual academics are left in many cases to find funding for their own research. If I may comment on Lord Butterfield's question about travelling funds, I would not perceive this as centrally a problem at Imperial College. Once you have established a relationship with a firm, if they really find value, they will fly you to the other ends of the world at their expense. I do not know if my colleagues would like to add anything. It is quite an important aspect because researchers have to retain contact with one another.

Lord Desai

30. Is there a conflict between what one might call pure or basic research and applied research? There may be scientist colleagues who want to do research which has no immediate application and no company may be interested, or do you not have such cases?

(*Dr David Thomas*) There are long-range subjects like astronomy and high energy physics that are funded by government. Most of our work I suppose is half way between that and applied research, so is in an area where industry really would wish to hold a watching brief. So much of the work with industry means they have people in various skilled groups throughout the world so they can monitor how something is developing. It is very valuable to them and it is very valuable to us in terms of getting support and interacting with the company so that we know they are thinking about what is going to be needed in future. Research is a living thing. We sometimes get a lot of feedback from a product to put back into research.

(*Professor Aleksander*) Maybe it is worth saying that the curious effect in talking to overseas firms is that the discussion very often opens on the basic fundamental work first. A department like mine works right across the board. With a United Kingdom firm it is the other way round, our discussion is only about applicable work.

(*Dr David Thomas*) As a small anecdote, a Japanese company who endowed a post at the college recently visited and talked to the researcher and asked him what he was doing. The research director of the company ended up by saying, "We are very pleased with that because it cannot have a use on the timescale of five years, but it is likely to have a commerical use between five and ten years. If it were within five years, we would already be doing it in the company".

Lord Nelson of Stafford

31. May I ask this of Professor Aleksander? I did not quite catch his point about the difference between the two approaches.

(*Professor Aleksander*) It is the question of short termism again. In discussion with overseas firms it is easier to talk about fundamental long term research than it is with a United Kingdom company.

32. You are looking for immediate results in specific areas?

(*Professor Aleksander*) Yes. Sometimes "immediate" is about six months, whereas our contacts with a Japanese firm, for example, are unlikely to have any benefit within the next two or three years but it is likely to pay off in ten years' time.

Lord Butterfield

33. Would that be because a British firm would have contacts with a range of British universities and therefore they are looking for specific things, whereas an overseas company would just look to one university and say, "We have a relationship with them", and that is it?

(*Professor Aleksander*) I feel not. There are very large British companies who have made it a matter of policy to state that their links with universities in general will progressively be based on much greater direction towards the needs of their customers rather than high risk research. This has been stated as a matter of policy to large companies.

Lord Perry of Walton

34. I know just how difficult it is to define "multi-national". My impression is that a very large amount of the money given, certainly in the pharmaceutical industry, is coming from companies that would certainly be regarded as multi-national. I suspect that is true in the electronics area as well. I just do not know whether any smaller companies that are certainly not multi-national are actually putting much into this at all, either overseas or internal.

(*Professor Howard Thomas*) The only example I know of is in biotechnology where you have relatively small concerns. I think the attraction of this environment to a multi-national which is providing a lot of the money, is that they have very clear

[Lord Perry of Walton *contd.*]

benchmarks. You might say this means that it is rather applied than blue sky research but even in some very basic areas you will get a biotechnology company which will say in a rather imaginative way, "We are going to do this and get the money". Then they set up the benchmarks. The attraction to the funder is that benchmarks are there and they can close it down at any stage.

35. We did a survey of biotechnology and again it is my impression nearly all these new companies are the creatures of the multi-national that set them up. How much of their investment in research depends on the subsidy from the parent multi-national?

(*Professor Howard Thomas*) I think it is dependent on the multinational company but it provides a nice environment where the scientists in universities get close to the money, if you like, to fund the research in a controlled and regulated way. You cannot expect people to put money in just to fund any idea. It has to be an arrangement where there is an element of measurement of progress incorporated in the contract. This system does that.

(*Mrs Clark*) May I mention the relevance of local companies in this context? Although I think your general point is absolutely correct, we do find that some of our local companies, the medium sized ones with less than 500 employees, do maintain good links with the university and provide us with a modest but very useful form of funding, perhaps through studentships or purchasing some of our research services. As they grow, that eventually leads to research collaboration. I think the motivation is simply that they are on our doorstep. Sometimes, of course, they have grown out of the university. At other times it is simply through the efforts of my own office, which obviously serves the local community as well as dealing with international collaboration. We try to bring the activity of the university to the attention of local companies. Although I would not say that we are as successful as we would like to be, I think, nonetheless, there is more going on locally than perhaps it appears. If I could just make another point, which goes back to the question of what does the university do to help scientists make this happen, one of the things which offices like my own and Dr Thomas's do is actually devise strategies and create frameworks which we know are going to be acceptable to the university but will meet the needs of the company and the needs of the individual scientists. That is really the most valuable service we can provide. There have been instances with companies, with Smith Kline Beecham, for example, when the scientist and the research director knew in a very broad sense what they wanted to achieve but they were not entirely sure how to go about it. In fact, I used the model which we had developed with Bristol-Myers Squibb through some other collaboration and suggested that framework which worked. I knew that there would not be any obstacles because the arrangements met all the university various university requirements. I think that is the most useful service which universities can provide.

(*Dr David Thomas*) Imperial College feels that the interaction with small companies is extremely important. We have a number of examples where I think it would not be an exaggeration to say the future of a company typically of 20 to 30 employees depends on the continuation of the successful collaboration with the college. In many cases we have found small companies are more generous according to their means than larger companies. I think that is extremely important because they are, as Mrs Clark says, local companies, United Kingdom companies. We do not visualise the same scenario happening, say, with a small American company.

Chairman

36. I think I can confirm that too from personal experience, that there is a great deal of regional loyalty with close contacts which have been most effective in developing that kind of collaboration. May I go back for one moment to the whole question of short termism? There is a truism which I have often used in medicine by saying that today's discovery in basic biomedical science is tomorrow's practical development in patient care. This applies across the field in many other forms of research endeavour. There has been for some years a kind of social attitude which one takes back, for instance, to the Rothschild proposals, that there should be much more direct research which would have an immediate consequence. That was when the money was taken from the Research Councils and was given to the customer departments in order to carry out what was called more operational research. I think that view spread, not only across that kind of background in government but into industry as well.

(*Dr David Thomas*) Perhaps I can comment on that, my lord Chairman. We have cases where we have talked to companies and the outcome is that they say, "Would you like to send us a proposal?" Then they say, "If we get a proposal, we will send it to our business division to see whether they will fund it". You know then that the answer is going to be no.

37. Are you aware of any comparable investment by United Kingdom companies in research developments overseas?

(*Dr David Thomas*) Certainly there is such investment by major multinational companies in the pharmaceutical industry, the chemical industry and the oil industry. They are known to be putting as much or more money into universities abroad than they are in the United Kingdom. We have talked to them about it. They say that they have to buy the expertise where it is available. It comes back to the quality of the research group and how well it is equipped. One cannot fault that. They are in business to keep their product-lines up to date.

38. We shall have to get that information from those companies, for example?

(*Dr David Thomas*) Yes.

(*Dr North*) Could I make one point in that context? I think in a sense it is a point which goes to the whole range of your enquiry. If we are looking at overseas investment in the United Kingdom and comparing it with United Kingdom investment, it goes back to Lord Perry's point because it is extremely difficult at times to know what you are talking about in terms of where the investment is coming from. We will leave with you a list of all the contracts that we have had over the last four or five years and the names of the

[Chairman *contd.*]

companies and where they come from but the reality is that the research funding from a multi-national from an office abroad may be coming from a substantially British multi-national and vice versa. It is actually extremely difficult to tell what the money flows are. If a multi national is investing widely overseas, you then really have to ask whether it is a substantially United Kingdom multi-national or not. I think it is an obvious point but not an unimportant one.

Chairman: We are aware of that difficulty.

Earl of Selborne

39. Could I come back to the role of commerce? I think Professor Howard Thomas mentioned the role of venture capitalists, particularly in biotechnology. It seems to me that the City has a role at a number of levels to play in attracting inward investment from wherever, this country or overseas, to research projects or even into endowments, certainly in start-up companies. Would you like to elaborate further as to how you see the role of the City and whether you find it is in any way helpful or not?

(*Professor Howard Thomas*) I do not know where the money comes from that funds the biotechnology industry that is present in California particularly. I suspect it comes from all over the world. The City of London investors will be involved as well as the Americans and Japanese. I think what the Californians have done is set up a micro-environment, if you like, where they can develop ideas from universities, usually along with people, and the commitment that the individual makes to the work by transferring from the university to the company is part of the reassurance that the company and the investor have that their money is going to be well used. If you put your own livelihood on the line by going into that environment, you will only be paid as long as the cashflow continues and that is dependent on you getting results. I think those companies which have been associated with biomedicine in the main, are an important concept in that they find a way of getting the various parties together, the financier and the scientist, but ultimately it is the multi-national who must take it on to develop it further.

40. To pursue that further, we have heard of the attempts to get alongside the manufacturing sector. Given that the manufacturing sector is declining, this is clearly an uphill struggle. To some extent this void might be met by closer links with finance organisations. I wonder whether universities target these communities specifically.

(*Dr David Thomas*) May I attempt to answer that by first giving some information. Imperial College has a technology transfer company IMPEL with which I am associated, which is a partnership with 3i plc, so we have very good contacts with venture capitalists. We do put proposals to 3i and they do consider them, we think fairly. My perception is that they are only interested in funding projects, shall we say, of a few hundred thousand pounds or more. To get a project out of the university lab probably requires development funding of a few tens of thousands of pounds and there still appears to be a development funding gap. In fact, with several projects IMPEL itself, is putting money in to try and bridge the development gap. 3i have looked at these proposals with us. Their conclusion is that it is too soon to think about start-up companies. They would not be interested in backing them yet. Unless projects can get to the stage where they can be looked at with a view to investing, they are not going to succeed.

41. Do you have any more favourable a reception from financial institutions overseas?

(*Dr David Thomas*) I think not. I would say that the overseas companies appear to be less risk averse.

Chairman

42. Does the same kind of process to which Professor Howard Thomas has referred in biotechnology also apply equally, for instance, to the development of computer software? Are you aware of whether the same sort of processes have been used in order to carry out development on an international scale with that kind of approach?

(*Dr David Thomas*) We have had projects at Imperial College that have been put into small United Kingdom companies which have major capital backing. These are in general fairly successful; some of the better ones, unfortunately, have been bought by American companies.

43. Again that is the point I was trying to get at. Many of these become perforce multi-national?

(*Dr David Thomas*) Yes.

(*Professor Howard Thomas*) There is one other issue, while we are talking about the environment and the funding. Of course, you are only attractive as an investment site if you have the reputation. Usually the first thing they will enquire into, is the level of existing funding. If you have 'blue chip' funding from the Medical Research Council or the Wellcome Trust then you are off to a good start. I do not want to give the impression that you can come in at the beginning of a research career on this. You have to have had enough input from these other bodies to generate the international reputation. Then you can start into the programmes I am talking about.

(*Mrs Clark*) I would like to reinforce that. There is no doubt that success breeds success. Certain organisations are more sympathetic to approaches for funding, whether they be venture capitalists or financial institutions, if they feel that one of their competitors for whom they have a high regard has already committed funds. It need not necessarily be to this project but to the same institution. There is no doubt that success breeds success.

Lord Nelson of Stafford

44. This is a question which relates to the exploitation of results of science and development. Has the university any experience or does it use the TEC organisations which have now been set up by government to enhance our industrial base, particularly by encouraging new businesses? Within the TEC organisations there are, of course, enterprise councils in each area—I happen to be chairman of one—which are set up in order to help organisations or individuals to set up new business in new fields. I wonder whether this comes into your thinking at all or whether you have any contact with these people.

[Lord Nelson of Stafford *contd.*]

(*Mrs Clark*) One of the downsides, if you like, of our success in obtaining external research funds is that a great deal of research which is carried out at Oxford is already earmarked to be exploited in a particular way, and that usually means by the company or other organisation sponsoring the research. The chances are that we will have negotiated an arrangement whereby that company takes over the exploitation of the results and clearly, if that is not a British-based company, then the exploitation takes place overseas. The fact that so much of our research is funded from these outside sources means that the opportunity for us to have inventions for which it would be appropriate to set up a company perhaps do not occur quite so frequently as one might imagine, if you look at the amount of research which is going on at Oxford University. However, when the opportunity does arise to set up a company, I think by and large it is fair to say that we tend to use the local resources. That does include the people who are active, whether they are part of an enterprise council or whether they are local banks which have a particular innovative approach to investing in new companies. We, in fact, have sought funding and set up a company with the owners of a local science park in Oxford. We tend to use the people we know. The reason for that is, of course, that they understand something of the work which is going on in the university; they understand the quality of what goes on and they know us. You can get down to business much more quickly if you are dealing with people you know. We do not use a formal mechanism. We do not use local organisations to assist us to find investments. We tend to do that through our own network.

Chairman

45. Going back to the question of intellectual property rights, when I was on the MRC sixteen years ago there used to be a body called the National Research and Development Corporation which was supposed to be responsible for exploitation of the results of Research Council funded research. Now it is quite clear, is it not, that this responsibility rests with the individual university? You have set up in Oxford Isis Innovation Limited and Imperial has set up IMPEL, your own organisations to exploit those intellectual property rights. When there is overseas investment, I gather from your documentation on both sides that you would seek the payment of royalties if those intellectual property rights are vested in the company that funds the actual research. If the intellectual property rights rest with the university, you have a mechanism in Oxford, a formula that up to a certain figure the actual money from an invention goes to the inventor and then a formula whereby the university benefits. Do you have any such formula at Imperial?

(*Dr David Thomas*) Yes, we do. The attitude of the college is to take a very serious look at what it is creating in terms of intellectual property. The technology transfer company, IMPEL, is asked to carry out a regular technology audit which involves visiting academics, talking to them and asking what they are doing, not only of scientific value but as to commercial potential, and then the decisions are taken about whether to protect by patent, and beyond that we look for a company that might be interested in exploiting this and then license the work or sell it.

(*Dr North*) I have an overall impression, really born from non-scientific experience, looking at it from the outside, that in the biomedical field particularly the sums of money which are likely to need to be invested in effective technology transfer of this kind are more substantial than those with which we have yet had to cope. There is a growing realisation, whether it is coming late, I am not sure, that some, for example, patent costs are going to be very high indeed. There is a very serious issue which I do not yet have the answer to but I am actually addressing my mind to it. It is a very serious issue of how universities are going to fund this and in collaboration with whom. It does seem to me it is actually a major matter that we need to address. My university is currently addressing it in one way. I think it is a very significant problem in this field.

Chairman

46. We are trying to dissect as best we can the advantages that accrue to the overseas company that invests in the institution. We recognise that that may lead to scientific discovery, intellectual property rights, from which they would benefit. Equally, we would like to be clear about the way in which the university itself, the college, can benefit from this inward investment in science. Do you, for instance, on research contracts from overseas companies charge overheads and, if so, at what level? In addition, some income would come from the exploitation of any inventions. If however there is no invention, does the university simply benefit from the reputation and the scientific discovery that arises from the research or are there other ways in which you can proceed?

(*Mrs Clark*) This may sound rather trite but it really depends what they want and what we can achieve by way of a financial return. By and large, we have a policy of charging 42 per cent overheads on all direct costs but in the case of these large scale overseas collaborations there are a great many items which go into the heading "direct costs" which you would not see, for example, on Research Council grants or perhaps on a fairly low key studentship with a British company. I think the cost of the research is inextricably linked to the question of intellectual property rights. If a company is prepared to meet the full costs of the research, depending on what the full costs are and how you calculate those, there seems to me no reason for the university to withhold the property rights but in the majority of cases Oxford shares the cost of the research with the company. In those instances if the university is sharing costs to a significant extent, and we would argue in most cases we do, then we feel the university should retain ownership of the intellectual property, not least because of the need to build on that work for future collaboration. If we assign the intellectual property rights in one collaboration and the company pulls out in three or four years time, we have to be able to sell our research to another customer. It is very important indeed that we can

[Chairman *contd.*]

bring forward the intellectual property, so we do charge overheads. We charge on work which the company wishes us to do and we charge what the market will bear.

(*Dr David Thomas*) The way the original contract is written is extremely important as far as ownership of intellectual property is concerned. You have to make the position very clear. Our policy at Imperial College, when working with industry, whether it be in the United Kingdom or abroad, is to recover full costs. We put a lot of effort into this and we now even ask academics how they spend their time as divided between teaching, research and administration. That is in order to be able to calculate overheads more easily. We charge close to 110 per cent on top of staff costs on the project. We normally charge that to overseas companies and whenever we can to United Kingdom companies. Some United Kingdom companies with whom we have had a long-established relationship show a resistance to being driven up the learning curve of paying full overheads. If the company wants ownership of intellectual property and is not prepared to pay royalties, there would be a premium above full costs. If the company is prepared to pay royalties, then we would regard that as "profit" back to the university. I have to say at the end of the day you have to negotiate with companies and strike the best deal you can.

47. You treat overseas companies equally in this regard?

(*Dr David Thomas*) Certainly. Treasury instructions would be that when one is working for private industry, one recovers full costs. One should not subsidise from government sources.

Lord Nelson of Stafford

48. Coming back to the question of costs, how is that decision made? Is it made centrally or is it made in your department? Who decides what is a direct cost and what is an overhead?

(*Dr David Thomas*) There is a definition of what constitutes direct costs given by the Research Councils which we use for industrial contracts too and then apply the overhead on top. All the estimates go through my office and are checked to make sure that nothing is left out or that salaries are not put in incorrectly. Before any cost estimate goes out, it has been looked at centrally by the College. Then negotiations will start with this figure on the table.

49. It would vary according to the amount of capital equipment involved?

(*Dr David Thomas*) The overhead applies to the manpower of the project only and capital equipment will be handled at cost. If we use existing capital equipment in this project, then there will be a rental added into the cost estimate. We really do try to be very businesslike in the way we cost research.

(*Mrs Clark*) Oxford operates in a very similar way. As the Director of the Research Services office, I have the responsibility to ensure the price is right and the terms are correct.

Chairman

50. There is a wider perception, of which this Committee is very well aware, that the transfer of infrastructure funds from the universities to the research councils has not resulted in them coming back as effectively as had been anticipated. That is a different issue outside the remit.

(*Dr North*) It is a very big difference.

Lord Desai

51. Dr North said biomedical research costs a lot of money and that he had to think about it. I want to ask whether there has been any collaboration between universities in jointly funding research or are there plans to do so?

(*Dr North*) My perception of the size of the problem is that it may well need to be tackled by collaboration between institutions or universities, That is perhaps a debatable issue but if there is to be an investment in the amount of money that is needed effectiveiy to deal with these high technology transfer costs in this field, I suspect it will have to come through some form of collaborative process. That is in a sense as far as my thinking has got.

52. You have no examples of such collaboration?

(*Mrs Clark*) We have a great many examples of research collaboration. We have had certain instances of collaborating with other organisations for exploitation of intellectual property, notably some of the medical charities. The Cancer Research Campaign has a company which exploits intellectual property and there have been instances when it has been agreed between us as to whether Oxford would take it on or the CRC would take it on and how we would then deal with the proceeds. That is not uncommon. In some instances we have exploited intellectual property in association with other universities, although actually rather rarely, partly because there has to be some interest from the other party and if people tend to move on to new universities, they may already have an income stream through royalties with us but their new research, of course, moves over to the new university. Exploitation tends to take place with the other organisations which are funding the work.

(*Dr North*) There tend to be two things. One is: Do you have collaboration with others in the development of any particular piece of research? That is separate from the point that was exercising me which is: Should one have some structure to which there might be more than one partner which addressed the issue of how the intellectual property might best be developed and utilised?

Lord Desai: You need a consortium.

Chairman

53. That was the whole purpose underlying the NRDC but it did not work.

(*Dr David Thomas*) I think there is a particular problem in technology transfer for universities. To do it properly in a university that covers science, engineering and medicine, you require a number of specialists in the technology transfer unit because you cannot transfer technology unless you understand the science involved. If you are talking

[Chairman *contd.*]

about drugs, you need a pharmacologist in the company because he will need to know about the science, the protection of the results by patenting, the pharmaceutical industry and how to negotiate licences. It is a very specialised business. To cover the range of science and technology encountered in a university probably takes at least six or eight specialists. It is unthinkable that with a hundred universities in the country, each one could justify having that expertise; it certainly would not pay. I do believe there is a problem here. I think the solution is probably a regional approach.

54. Lord Nelson mentioned a centre. Has this been discussed by the CVCP?

(*Dr David Thomas*) As far as I am aware, no. IMPEL has recently done work for the National Health Service where exactly the same technology transfer problem is found in hospitals. Much of the work in hospitals, of course, is done in collaboration with universities. It would make a lot of sense for the teaching hospital and medical school to have the same technology transfer unit. My concept is that, say in west London where the College is based, we should be looking towards a common technology transfer service for other local research organisations. We already have an arrangement with the British Postgraduate Medical Federation We do technology transfer for them and for Birkbeck College. We are trying to move towards a technology transfer unit that is above threshold size. There maybe a problem there of getting universities and other organisations to collaborate in this way. There are also lots of government laboratories nationwide that are quite small and not able to do the whole job themselves. My perception is that a regional approach is the right way. The British Technology Group is an organisation based centrally and that has some disadvantages in that it cannot know what is going on in research everywhere. IMPEL has representatives in each one of the institutions we deal with who know what is happening on the research side. The person concerned is usually the research contracts officer, so knows almost where the results are going to occur before they do. They will call in the experts at the right time.

Chairman

55. One of our reasons for looking at the whole question of overseas postgraduate students is because of the belief widely disseminated in the past that people coming from overseas to this country to do postgraduate study will subsequently use British products and develop British ideas on returning to their own countries. I am not sure whether you can give us any evidence supporting that view or not. Do you believe there is any relationship between efforts to attract overseas postgraduate students on the one hand and efforts to attract overseas investment on the other or are the two totally unrelated?

(*Dr North*) I do not think they can possibly be unrelated. I suspect there may well be a substantial timescale between them. In a sense this probably gets us into the broader issue of the attraction of the overseas students. Clearly there should be a connection between attracting overseas graduate students, post-doctoral students and links with the institutions, the companies, the foundations or whatever it is in which they end up working. I would have thought it would be unusual for there not to be such a connection. I am not saying that one very crudely buys an entré by taking the post doctoral or the full PhD student but I would have thought that there is a long term investment, a national investment, in the understanding and the experience of the way that our university and science systems in particular work which has a spin-off. It may be a twenty year spin-off. That point can be made about investment in overseas students generally. I think it can be made just as well about science students. I I am not sure that it is particularly stronger there because of the broad political connections that one might get from students in the humanities.

(*Dr David Thomas*) May I comment that 38 per cent of the PhD students at Imperial College currently come from outside Europe. Of course, being Imperial College, it has always had strong connections with the Empire, as it then was, and the Commonwealth. If one visits countries like Hong Kong and Singapore, where there is a feeling and the college is well known and is certainly well thought of, I think this must help business, but probably on a twenty year timescale.

Lord Nelson of Stafford: May I comment that I think the overseas students coming, as you say, to Imperial and then going back home is of as big a value to British industry as it is to industry in the countries from where they come. Those contacts can be very helpful to British exporters.

Chairman: Except, of course, that many of the Pacific tigers are now being very competitive indeed and some of them are led by ex-British postgraduate students. That is a problem, I think.

Lord Perry of Walton

56. Are there factors that you would pick out which lead to overseas graduates and post-doctorals coming to this country rather than going to other countries in the developed world?

(*Professor Aleksander*) Perhaps I could start by commenting on that. It is a very competitive business. At Imperial College the postgraduates, as indeed must be the case at Oxford and Cambridge, are probably the best postgraduates in the world. They have a choice. The choice is usually between the United Kingdom and the United States. One of the points where we lose is that in the United States in particular there is an investment in equipment and in staff that we cannot match here; yet we do not lose as much as one would expect. It is a competitive business and we certainly keep an eye on it by having good contact with the education ministries in those countries.

(*Dr North*) I have heard the comment made and I make it here but I do not know what force there is in it, that there are clear and identifiable advantages in coming to some institutions in this country rather than some institutions or a range of institutions perhaps in North America because in a paradoxical way we have fewer resources in our science departments at our disposal and therefore the

[Lord Perry of Walton *contd.*]

problems cannot necessarily just be attempted to be solved by throwing money at them. They have to be rather more carefully thought out because there is less money and many of these people will be going back to countries where there clearly is no opportunity to throw money at the problem to solve it. Arguably, there is an attraction here—I would not put in a plea for penury— that in a sense the problems have to be solved sometimes in a slightly different way. I have heard the case made but I have no means of quantifying the strength of it.

(*Professor Howard Thomas*) In postgraduate links with Japan, previous experience is all-important. You almost get "Lineages" of post-docs—each one recommended on the basis of the experience of his predecessor. Certainly, my experience is that there is a very effective way of communicating with the Japanese academic community.

Lord Perry of Walton

57. If one was to find things that would improve the attraction of this country, it would basically be the equipment of the department that you put at the top?

(*Professor Aleksander*) In some areas that would certainly be the case. The contrast is quite startling for, say, a Brazilian student who has done an MSc in Brazil, which is not normally considered to be a high tech country in that sense, who finds in coming to Imperial College, which he or she would see as a pinnacle of excellence, one cannot get on to a computer for the first three weeks of being there. Things may not be that bad. Particularly with South American students, there has been a lot of that sort of discussion.

Chairman

58. Pinnacle of excellence is the point I wanted to talk about. Is there an attraction based on the view that the quality of British science still stands exceptionally high and it has a reputation across the world? Is this one of the reasons why people are attracted to bring investment here and to send their students here?

(*Professor Aleksander*) There is this view, but we are hanging on to it by the skin of whatever!

Lord Butterfield] My point was to back Lord Perry about the apparatus. I found when I was in Japan and dealing with the Japanese that they have almost a worship of the student- teacher relationship. In fact, I was asked if I would consider setting up a boarding school in Japan because they felt that our system, which included boarding schools, encouraged individual thinkers in a much more pronounced way than they got in their large schools. Again, I feel from interviewing candidates in the Far East on where they are going to go, many of them would like to go to America but they are conscious that there they will be immersed in a very large institution, whereas if they come to our institutions, the chances are they will have much more contact with the staff. The sort of joke they make is that the high-powered American scientists are so busy flying around America to meetings that they never see the students, whereas in the older universities here something tethers the staff to their college or whatever, and the students do get more opportunity actually to talk out how to do an experiment without any apparatus.

Chairman

59. The travelling academic is not unknown of course in this country. We know of the extent of your involvement with science parks. What do you see as their aims and objectives, their value?

(*Dr North*) I think one clear aim and objective is commercial. I think they are being perceived as a way of making money. That has the effect that they tend to be expensive. One of their attractions is their appearance and the facilities that go with that appearance. Therefore, that does raise the cost. They do seem to me to be there in order to interlink with or feed off the intellectual endeavour of the institutions to which they may be close. You refer to one instance in Oxford. There are now three or four science parks around. Our spin-off companies, if I can describe them as that, have not all gone into one but into different ones and they clearly had different attractions there such as the science park being in an environment which is useful to them in two ways. One is that it is simply a place, an area, where these high technology ideas are talked about. It is a very amorphous concept. As part of the discussion in the community it is important. More directly, of course, there is access to the able individuals in the university or colleges or institutions to which they are close. It does seem to me one of the aims and objectives of those who run the science park is to put them in an area where they can be attractive to those who are going to be there because of these interlinks and where the environment is such that it is going to be attractive to the able people who would want to work in the companies that are there and thus enable others to be attracted. They feed off one another.

(*Dr David Thomas*) Of course, there are commercial reasons associated with rental income for science parks. Central London colleges have a particular problem because of the price of land. Imperial College is associated with two science parks, one near Heathrow Airport and one in collaboration with the Welsh Development Agency in Wales. It is not so easy to lecture in the morning at Imperial and visit a science park company in the afternoon. Nevertheless, our intention is to try and get into the science park a group of companies in high technology and to service those by having an individual who visits them regularly to see how the college research programme could help, or whether they want special courses. The best way of describing it is to say the commercial aspects pay for the operation. One would hope to get additional benefit in terms of research and consultancies for the university. That is quite difficult to arrange in practice.

Chairman: Are there any supplementary questions from members of the Committee? If not, Mrs Clark and gentlemen, we are very grateful to you.

[Chairman *contd.*]

Supplementary Memorandum from Imperial College
Research Grants and Contracts accepted between 1 August 1989 and 31 July 1993

		£	£	%	%
All Grants and Contracts awarded (2,602 projects)			186,157,026		100.00
of which Overseas Grants and Contracts (495 projects)			34,745,972		18.89
Breakdown of Overseas Support by Type of Sponsor					
Overseas Industry			8,286,850		4.55
of which:	European Union	1,375,571		0.74	
	Non-EU Europe	1,834,210		0.98	
	USA	3,011,948		1.62	
	Japan	1,519,317		0.82	
	Other	545,804		0.29	
Overseas Government Agencies			6,299,744		3.38
of which:	USA	1,803,968		0.97	
	Japan	*2,500,000		1.34	
	Other	1,995,776		1.07	
Overseas Charities			1,987,887		1.07
of which:	Non-EU Europe	820,746		0.44	
	USA	1,167,141		0.63	
European Commission			17,586,720		9.45
Miscellaneous			820,746		0.44
	Total		34,745,972		18.89
Breakdown of Overseas Support by Country of Origin					
European Union			1,375,571		0.74
Non-EU Europe			2,654,956		1.43
USA			5,983,057		3.21
Japan			4,019,317		2.16
European Commission			17,586,720		9.45
Miscellaneous			3,126,351		1.68
	Total		34,745,972		18.89

*FOOTNOTE. This is the 50 per cent Japanese contribution towards a jointly-funded programme in Semiconductor Materials involving support from the Japan Research Development Corporation and the UK Science and Engineering Research Council.

WEDNESDAY 23 FEBRUARY 1994

Present:

Nelson of Stafford, L.
Perry of Walton, L.
Porter of Luddenham, L.
Selborne, E.
Walton of Detchant, L. (Chairman)

Examination of witnesses

DR GEOFFREY ROBINSON, Chief Adviser on Science and Technology, DR RICHARD HINDER, Head of International Branch, Innovation Policy Division, and MR CHRISTOPHER PRISTON, Head of the Invest in Britain Bureau, Department of Trade and Industry, were called in and examined.

Chairman

60. We are very grateful to you for coming along this afternoon. I would like to say, Dr Robinson, if I may, how grateful we are to you for fitting us into your diary because we believe that your appointment to the Department of Trade and Industry is about to end and, therefore, our special thanks are due to you for being able to come and see us and to tell us about some of the questions we want to pose.

(*Dr Robinson*) Thank you very much, my Lord Chairman, for that kind introduction and thank you for giving me the opportunity to speak to you this afternoon. I am mindful, as you say, that my term with the Department comes to an end on Monday formally. Tomorrow is actually my last day of work.

61. I did not realise it was as close as that.

(*Dr Robinson*) But, as I hope will become clear during our session this afternoon, this is a subject which I do think is very important, so, therefore, if I can personally help, I am happy to do so. I am also conscious that in my remarks I should remind you that I worked for an overseas multinational company investing in research and development in the United Kingdom for 23 years and am about to do so again and while I am not here formally representing IBM, I cannot in any way wipe that experience from my mind, so at times I may allude to that background. I am joined, as you will observe, by Christopher Priston who is the Head of Invest in Britain Bureau and Richard Hinder who, as you know, was formerly the Science and Technology Counsellor for Japan and most recently has been set up within my part of the DTI with a particular remit to help United Kingdom companies take advantage of technological links with overseas countries. In terms of introductory remarks, I think I would like to keep them clearly brief because we have a big agenda and we will go wherever you wish. I think it is important to recognise that the subject has become more topical recently, particularly with reference to Japan. However one does not overlook the fact that the track record of European and American companies who have invested in United Kingdom science and development opportunities is very long and indeed significantly larger than Japanese-scale activities at the moment. Secondly, I think as you alluded to in your introduction, we need to be clear as to whether we are talking about investment in research opportunities within or without universities, as opposed to market and product development opportunities. Sometimes we link the terms "research" and "development" very closely and often, of course, they can be far apart in terms of the nature of their activities, so it might be helpful sometimes to tease out that distinction between research and development and patterns of inward investment. Finally by way of introduction, I think the DTI has got a long and successful history of attracting inward investment into the United Kingdom. Since my time at the DTI, partly through my initiative but partly coincidentally, we have been looking harder at the pattern of research and development investment, as opposed to focusing largely on manufacturing which is where we have been. So, in that respect, your enquiry is very topical as well.

62. Thank you very much. I think, to make it clear, we are interested in research whether in universities or elsewhere and we are interested also in development. We are not looking, however, at direct investment from overseas in manufacturing industry as, for instance, with Nissan in the north-east or Sony or Hitachi in other places, except insofar as we would be interested in such investment as may be relevant to improving motor car design or improving design of electronic equipment and so on, but it is not direct investment in manufacturing *per se* with which we are concerned and I hope that clarifies the position.

(*Dr Robinson*) Yes, we certainly appreciate that.

63. Now, Dr Hinder, could you just explain the role of the Innovation Policy Division and your responsibilities as head of the International Branch at the DTI?

(*Dr Hinder*) My Lord Chairman, the new branch was created just seven or eight months ago and we are responsible within the innovation policy side of DTI for promoting the overseas technology brokerage arrangements which were heralded in the White Paper on Science, Engineering and Technology last year. This is a framework. The overseas technology brokerage service encompasses many activities, such as missions of experts who visit overseas countries in order to find out about developments in technologies, in science, in markets, and to establish contacts for commercial and scientific reasons which they then later exploit and develop. It also goes further than that into individual secondments of industrialists, industrial researchers and industrial engineers who spend time, perhaps a year or so, in relevant organisations which in most cases would be companies overseas. An example of that is our Engineers to Japan scheme where there are currently a dozen people in Japanese companies from United Kingdom companies. Then there is a third leg to the

[Chairman *contd.*]

overseas technology brokerage arrangement which is the collection and analysis of information, information of many kinds about new markets, new technologies relevant to the Foresight debate which has been continuing in the United Kingdom since the White Paper.

64. Information to whom?

(*Dr Hinder*) Information to industry, to academia, to government. We run the Overseas Technical Information Service for that purpose and we have a network of representatives overseas which we tap into. Those are the Counsellors and First Secretaries in embassies throughout the world and we also have the network of British Council Science Officers which can be helpful in establishing networks of contacts and provision of information on overseas developments to the United Kingdom.

65. Does that mean that your network overseas is related to particular attachés or embassies and other relevant organisations or do you have any direct relationship, for example, with the British Council?

(*Dr Hinder*) We have direct relations with the British Council as we do with all the attachés.

66. The attachés as well?

(*Dr Hinder*) Yes.

67. Dr Hinder, could I just ask what your own personal background of training and expertise was before you took on this job?

(*Dr Hinder*) I was a radio astronomer at Cambridge University. That is where I did my research and following that I was with GEC as a telecommunications engineer, a radio propagation expert, and then in management consultancy, later at the Home Office, as a Director of Research, and then with DTI, the Foreign Office in Tokyo and then back to DTI again.

68. Mr Priston, tell us about the Invest in Britain Bureau.

(*Mr Priston*) The Invest in Britain Bureau is part of the Department of Trade and Industry and in fact was set up in the Department of Industry in 1977, so it is a venerable part of the Department and has survived in much the same form ever since. It operates overseas through our Foreign Office colleagues in the major posts. We have some 33 full-time Foreign Office staff working on inward investment promotion, principally in the United States, then in Japan, and some full-time staff in Germany and Switzerland, Taiwan and Korea. In all other posts it is carried on part time, as one of the many duties of the Foreign Office people who are based there. The United Kingdom end of the operation consists of the IBB which has just under 50 people in it.

69. The IBB?

(*Mr Priston*) Invest in Britain Bureau. I must not slip into acronyms too soon. The Bureau itself actually operates a distributed network, throughout the United Kingdom, of regional development organisations. In England, there are currently six of these which we fund, the largest of which is the Northern Development Company in the north-east, for example, which is a sizeable organisation in its own right with 100 or so employees. We also network with the Scots, Welsh and Northern Irish. They have, from their own Secretaries of State, their own funding, but they run very similar promotional organisations to the English regional development organisations and like them they too have a few staff of their own overseas, but not the same numbers as the Foreign Office deploy for us. In total this means that we have overseas and in the United Kingdom a considerable resource devoted to inward investment promotion which is coordinated by the Invest in Britain Bureau. But it is run very much on a regional basis. Our belief is that the regions are best placed to attract investment to their area because they know their universities and their local academics, they know the strengths of their existing companies, or should do, and, of course, they are in a position to sell—if I can use that word—the site more effectively than we could sitting here in London. So the process is to get the enquiries by various forms of promotion overseas. In Japan we recently had an R&D seminar that attracted 295 people. We follow up those people. We may invite them to come to this country. Individual investors are visited. We, through our network, visited 2,500 companies last year. The territorials, that is the Scots, the Welsh, the Northern Irish, and the English regions visited an equal number and the whole object is to get someone to come and look at something in this country. To do that we have to work very closely with all the English, Scottish, Welsh and Northern Ireland regions, through them the local authorities, and in this way network with the science parks, universities, whatever it might be that the investor is looking for.

70. So is there a formal co-ordinating machinery that would allow your regional organisations, for example, to keep in touch with the universities in the regions to be sure that they know of any initiatives that might be coming forward from those universities to companies overseas? What about the role, for instance, of the Training and Enterprise Councils? Do you have any formal relationship with them in the regions?

(*Mr Priston*) If I may deal with the last point first, the relationship with the Training and Enterprise Councils, and in Scotland they are called something slightly different, the local Enterprise Companies, is an informal one. We are trying to develop a closer relationship. We wish more regions to be like, for example, the north-east and the East Midlands where the Training and Enterprise Councils are well integrated with the local inward investment agency.

71. I am delighted to hear you say that about the north-east from which I come!

(*Mr Priston*) It is a shining example, my Lord Chairman, of how inward investment promotion should be arranged and I am happy to put that on the record. The TECs, if I can use the short form word, in the East Midlands, for example—and it is not the only place it happens—are subscribing members of the overall umbrella organisation (East Midlands Development Company) and have an input to it. They have a representative on the Board and in that way they are brought into the picture. The position is not so happy in all regions yet. There are 80 or so TECs in England and it is quite a business for them to co-operate with each other and then with other

[Chairman *contd.*]

organisations in the regions. Turning to universities, again there is no formal machinery, but it is interesting how, for instance, in Devon and Cornwall and again in the North-East there are regular meetings with the principal universities on inward investment matters. Furthermore, these bodies call on suitable representatives of universities to meet inward investors when we bring them into the country, when we know that they are, for example, interested in bio-technology or whatever it might be. It is informal and we leave it to each region and each university really to put in as much or as little to that effort as they think right for their circumstances.

72. Thank you. Would you welcome and would you regard it as being appropriate that there should be more formal consultative machinery particularly in those regions in which it does not exist at the moment?

(*Mr Priston*) I think consultation is always desirable. I would not want to be prescriptive from the centre as to how they should set it up.

73. Is there more overseas investment in UK science in some sectors than in others? Which, and why? Is there more overseas investment in UK science from some countries than from others? Again, which, and why?

(*Dr Robinson*) The data that we can share with you is based on information supplied by the Central Statistical Office who poll companies and therefore the data actually comes from the companies themselves. The figures that we have indicate that the overwhelming proportion of inward investment in R&D is essentially in three sectors. The largest single one is in the electronics, the second is in the chemicals and pharmaceuticals sector and the third is in vehicles, in that order, and they account for about 85 per cent of the total inward investment in R&D.

74. When you say "vehicles", you do not mean vehicle manufacturing, you mean vehicle development?

(*Dr Robinson*) Indeed so. We are taking our definition of science and technology research and development to be exactly your remit.

75. Thank you.

(*Dr Robinson*) There is clearly a grey area around the product improvement part of the spectrum, but insofar as one can differentiate development from manufacturing, then we have taken that distinction, so none of this data includes straightforward manufacturing data. Some examples perhaps of major investment that you may or may not wish to follow up are in the chemicals and pharmaceuticals area. One could cite Procter & Gamble, Rhone-Poulenc, or Roche products from Switzerland. In electronics we have this rather special case of Fujitsu and ICL, depending on how you want to categorise that. More recently places like Sharp Electronics and Canon are setting up small facilities. Companies from North America, Motorola, my own former IBM, Northern Telecom, have got major R&D investments in the United Kingdom. From Europe, Philips has a research establishment at Redhill. In the vehicles area, again the very special and topical case of BMW and Rover. In our data, of course, that is counted as British to date. The single major one from Japan is, of course, Nissan. The Nissan investment in R&D, which is split between their site in Sunderland and a group that they have in Cranfield, is the single biggest Japanese investment in R&D in the United Kingdom. Then Ford at Dagenham have a very major R&D facility and it is possibly the largest inward investment R&D operation in the country. So those are the three sectors, chemicals and pharmaceuticals, electronics and vehicles. In terms of the split from different countries, perhaps to put it in context, of the total expenditure on Business Enterprise Research and Development in 1992, one was looking at a total of approximately £8 billion on R&D investment, of which about 23 per cent, according to our statistics, was performed by overseas controlled companies. Of that 23 per cent, 13 per cent came from the USA, which is about £1 billion inward investment in R&D from the USA, about four per cent, which is just over £300 million, was from Japan, and I should perhaps stress again that includes ICL as being ultimately owned by Fujitsu, and then the rest from around the world, EC, EFTA and countries like Canada. That is the broad pattern if that is helpful.

76. Do you have any comparable figures at all relating to outward UK investment in R&D and science in other countries?

(*Dr Robinson*) We certainly do not collect them in the formal way that would allow me to answer your question. Although the DTI helps companies in their outward investments, it is not necessarily something that would be directly visible to us.

Lord Nelson of Stafford

77. I wonder, my Lord Chairman, if we could pursue this question a bit further as to who the countries are that favour coming to this country and why, and why specifically the fields which you have mentioned. Why not aerospace, for instance, which is an international business, or why not nuclear power which is an international business? I am not clear what it is that activates certain countries to come here and why it is certain areas which are attractive and not others.

(*Dr Robinson*) I would again perhaps draw the distinction between major investments in development activity, from small-scale investments in research, and by and large, for most companies that I have talked to at least, their significant development operations are usually tied both to manufacturing in some way, but also in terms of developing local products for local markets, and we may get into a discussion as to whether local is the United Kingdom or local is Europe in this sense. I cannot comment in detail on why companies do not come, who do not come almost by definition, but I think the investments that we have seen tend to be in the market places which are growing the most rapidly, for fairly obvious reasons, and that are perhaps more open to a perceived level playing field in international competition than others, as seen by those companies. I could not comment in detail on the investment plans of companies that do not come. As to from where they come, and why they come, I think again one has to differentiate perhaps almost three generations. Some of the major American

[Lord Nelson of Stafford *contd.*]

companies have been here for many years since relatively shortly after the second world war, as part of their own globalisation strategies. Then we have seen a steady growth in European investments over the past 10 to 15 years, and then most recently, probably only over the past five years we have seen the beginnings of the trend from Japan. I have talked to a number of Japanese companies about why they are investing, firstly, outside Japan and then why they come to the United Kingdom. There are two reasons that they give for investing outside Japan, both of which I have already touched on to some extent. The first is that they increasingly see the need to adapt their products to local markets and developments growing out of their manufacturing base serve the European market place better. I have mentioned Nissan, and the Chairman mentioned Sony who are doing development work. They are built as an adjunct to their manufacturing activities. The second reason that they give, and it is a fairly typical Japanese reason, is that they believe that the West has creative abilities that the Japanese do not have and increasingly, as valued-added products need an element of creativity or innovation or flair or design, then they wish to get access to that skill which they feel they do not have in Japan. Sometimes that is in universities and sometimes it is in the commercial design community. These are the two reasons that largely they give. As to why the Japanese come to the United Kingdom in particular, in what I must admit are informal discussions with many of them rather than a formal consultation, the same answers keep coming back. The first and most important is "Because the United Kingdom welcomes us". They are welcomed at the government level and they feel they are welcomed at the social level and that is a very significant factor for the Japanese.

78. I hope they will say that after Rover!

(*Dr Robinson*) Your point is well taken, my Lord. The second reason that they give is the language. They feel comfortable with the English language which is a very major factor for them. When pressed on why they choose the United Kingdom rather than the rest of Europe, from a creativity point of view I have to admit that often they are rather tactful, but admit, on pressing, that the quality of the science in the United Kingdom compared with the rest of Europe is not an overwhelming reason for why they choose the United Kingdom, because they feel that wherever they come in Europe, they are going to tap into the best science wherever it is and they can do that from the United Kingdom or from anywhere else. They do not feel that the quality of the science *per se* is outstandingly better in the United Kingdom than the rest of Europe. Those other factors, the welcome and the language, are the predominant ones.

79. Do the DTI see that they should have a proactive role in this field? By that I mean actually taking the initiative either with foreign firms in promoting or selling an idea or with industry within this country and specific companies to ask them why they are not doing more and why they are not working more closely, for instance, with the universities, which was said earlier that they work short-term with the universities, whereas the foreigners think more long-term? Do the DTI see their job as being more proactive in promoting for the whole of British industry?

(*Dr Robinson*) The brief answer is yes. To elaborate, I think your question touches on perhaps two separate but related issues. One is the specific question of inward investment in R&D and the second is the broader question of strengthening links between industry and universities. On the first question of specific investment in R&D, this part of the DTI has been quite proactive over the last 18 months in raising the level of importance of this question and we have gone about it from the following point of view. Firstly, the world of research and development is becoming increasingly international. In all honesty, it always has been, but we are recognising that there is really only one research and development ability around the world. If the United Kingdom wants to succeed long term in the future, we have to hold our own as a place in which research and development is done, not just in the science base but in industry as well, and that means being truly global in that mind-set. We recognise, and perhaps this is part of the background that I brought to the debate, that as far as American and European companies are concerned, it has been going on an awful lot already and we just did not happen to notice it very much. But there did seem to be a pattern emerging of increasing Japanese interest and so colleagues and I put some time in to visit Japanese companies here in the United Kingdom to ask, "Why are you here? What was your experience". Then, as Mr Priston was saying, we organised a seminar in Tokyo in the autumn of last year when Mr Waldegrave and I spoke about the United Kingdom as a place in which to do R&D, to explicitly start the process of attracting them. We did find in that experience that many more companies than we had anticipated in Japan were actively considering the issue as part of their globalisation strategy, as part of this need to get more creative, inventive thinking into their products. Many of them, on pressing, did admit that they were thinking that when the economy improved again and they were looking at overseas investment opportunities again, R&D would be quite high on their list of priorities. The last point I would just make is that we do consciously recognise, that this is a subject that could be quite contentious. There are arguments that flow backwards and forwards about overseas exploitation of United Kingdom brains and so on. The United Kingdom has taken a very positive view that being part of the truly global, multinational economy, we have to accept that on average we are going to benefit from strengthening those international relationships, and so we are proactive.

Chairman

80. We have heard in this enquiry already and in others a number of complaints from those who are in science in the universities, for example, to the effect that United Kingdom companies take a short-term approach to investment in R&D and development, whereas overseas companies are more prepared to take a longer-term view in being prepared to put money, for example, into basic research which may

[Chairman *contd.*]

ultimately turn out to have some kind of product at the end of it, but not in the short term. Now, is that something that has come to you or is it something that you would deny?

(*Dr Robinson*) The fact that people are saying that, has certainly come to us. The reality of the situation is slightly more complicated. If I can just tease out two or three issues. Let me stress up front that it is a concern. We do fear that there is not as much long-term investment in R&D in UK companies as perhaps we would like. The elements of the picture are as follows: firstly, the pattern of changing interest rates, changing inflation rates itself is recognised to have been a deterrent to long-term investment in general and the policy of the Government to try and get low inflation and stable interest rates, I think, is the key in order to disentangle the short-term money phenomena from long-term investments of whatever shape or form. Secondly, I would ask that whenever we make a negative comment about British industry, we actually think which company we had in mind when we made that statement, because for good or ill often when one finds, shall we say, Japanese or overseas companies investing in a particular area of research in universities, one finds that there are not the British companies who are in that marketplace who would have done that investment. So unless one actually addresses the question of which particular companies are working in this area, then any generalised statements about British companies can be very misleading. I think the third point that I would make, and I am not sure whether it proves or counters your case, is from my own personal experience in that all the decisions in IBM about whether I had any links with UK universities or not when I was running my laboratory, were my decisions. They were not decisions taken in corporate somewhere. Certainly, I was very proud of the links that we had with universities developed over a long time. Whether you ascribe that to it being an American company or not may be very dangerous, but some people in British companies do have very good track records of working with universities.

Lord Perry of Walton

81. The areas you talked about, which were electronics, pharmaceuticals and chemicals and vehicles, are all handled by multi-national companies on the whole. As you said yourself, they are internationalised. I was just wondering whether there were any examples of companies that were strictly not internationalised which did get involved in this to any extent at all?

(*Dr Robinson*) I suppose I would probably have to say that if they were not part of major sectors and were not international in scope, it would be quite hard for us to know that it was going on and in this whole area I do have to stress to your Lordships that knowing exactly what is going on is very hard to find out. I think I would say that probably by definition there is not much of it. I would, if I may, add one extra point, which may be peripheral to your enquiry but it is nonetheless important, that there is a growing recognition that much innovative work is done in small companies. There is a growing recognition that if you are in a technology-based industry, even if you are a small company, you have no choice but to be world-scale in your thinking. If I may, the phrase I use is, "there is no such thing as the niche market for scanning electron microscopes in North Northumberland". It does not work that way and, therefore, any technology-based company has got to be global in its thinking. Economies of scale, particularly economies of human intellect scale, are such that if you are a small company it is unlikely that you will be scattering your research and development activity around the globe. It is more likely that you will concentrate it somewhere and then try and market it around the globe.

82. My second question on this is that I get the impression that the R&D is internationalised but the manufacture does occur in the vehicle area in this country but very much less in the chemical area or in the electronics area. In other words, the investment is in the R&D but often not in the manufacturing of the product that comes out of the development?

(*Dr Robinson*) Yes, I think in your enquiry into comparing between different sectors, you of course have to recognise that the role of R&D in the total business spectrum is quite different between different sectors. In chemicals and, in particular, pharmaceuticals, one is talking about an industry which is extremely research intensive. The manufacturing is relatively straightforward—not as straightforward as many people think, but relatively straightforward. When you compare it with the automobile industry, the R&D is often much further down the supply chain, which is where the invention and innovation goes on, but the automobile manufacturing component itself is very significant. The role of R&D versus manufacturing will, therefore, be quite different between different sectors. The other point that one has to recognise is that the personalisation of the products to local markets can be quite different between different sectors. Therefore, there is the need to recognise that the European marketplace for cars, is actually different from the American marketplace for cars which in turn is different from the Japanese marketplace for cars. The worldwide marketplace for chemicals is much more uniform and so you do get these changing patterns. I hope that is helpful.

Earl of Selborne

83. I would like to follow up that very interesting point which Dr Robinson made about the degree of innovation in small companies and the fact that there will not be necessarily a local market for their product. Does this perhaps put a finger on some of the problems which the United Kingdom manufacturing base has suffered from and perhaps this has contributed to its decline? In a sense, have some of our leading companies been over-dependent on Government for their long-term product specification and has Government itself never thought it important to ensure that the products that they are demanding are compatible with the wider global market?

(*Dr Robinson*) I think I draw a distinction between three product areas: the first perhaps is pharmaceuticals where, of course, the Government is a major purchaser of pharmaceutical products and

[Earl of Selborne *contd.*]

recognises the importance of R&D in the purchasing arrangements of pharmaceutical products, but the products when developed do compete on a world market. The same to some extent is true in defence. The defence products compete on the world marketplace and have to hold their own against competitors from overseas, although it is a marketplace in which Government itself is perhaps more intimately involved directly than it is in the pharmaceutical marketplace. In other sectors of the economy you probably have to recognise that, by and large, Government is not a leading-edge purchaser. Government is not a major purchaser of consumer electronics, to take it in the extreme and, therefore, the Government, I think, recognises the need to be quite careful as to what extent it tries to lay down standards for products where it itself does not have leading-edge requirements. Otherwise the danger is that you create local marketplaces with local standards which then attracts companies to focus on those marketplaces rather than the global ones.

84. I wonder at the risk of straying into our other enquiry of the other Sub-Committee if I could come back on the defence sector. I was surprised that Dr Robinson thought that the Government had on the whole been able to anticipate the wider remit of the defence industry, the suppliers, when preparing their specifications. It does seem to me that the Ministry of Defence does not recognise that it has any such responsibilities; it is simply there to spend money on defence of the realm and because of that large sectors of industry have been led to a very precise requirement which has not in fact had a lot of application.

(*Dr Robinson*) I may have slightly worded my answer in a way that misled you. Firstly, the point I was trying to establish is that in the defence business and marketplace itself, the Government's requirements, by definition, have to be near the edge in order to have effective weapons. The extent to which that has the effect of focusing companies on Government business may be slightly misleading in the sense that companies who are in the defence business, wherever they are, are in public sector business. As to the broader question of whether the Ministry of Defence should have a broader remit in industrial affairs, I would have to bow to the judgment of Ministry of Defence colleagues and perhaps your question should be addressed to them, if I may say.

85. I am probably sitting on the wrong Committee!

(*Dr Robinson*) Or you have the wrong witness!

Lord Nelson of Stafford] As a follow-up to that point, might I quote another field and that is medical equipment. They really only have a single customer in this country for medical equipment and yet they take no steps as far as I know to ensure that the medical equipment is right up to the latest scientific standards. In fact those who are in that business go to America to do their research because it is not attractive to do it here.

Chairman

86. It has been put to us that one of the reasons for the failure of many of the companies involved in the broader medical and scientific equipment field has been high interest rates and other similar problems. We used to make CT scanners and we no longer do. We used to make very good electron microscopes and we no longer do, yet for some reason they are still made in Holland. We used to make magnetic resonance imaging magnets and so on and they are now being made in Japan and elsewhere. What is responsible, following up Lord Nelson's point, for this real problem that has afflicted British industry?

(*Dr Robinson*) If I may, let me again try and emphasise the two separate issues, both of which are important. The first is the general point which you raised about investment in R&D and staying at the leading edge of technology whether it be civil, military, medical, electronics or anything else. We touched on the reasons for the concern in terms of the macro-economic climate and also the desire to raise the awareness of the whole subject of the importance of R&D and the relationship between the City and the Government. So it is a big subject into which every sector that you might raise is relevant in one way or another. The separate subject that Lord Nelson raised is really to do with the role of government as a customer in one sector or another. Now, the first point I would like to stress again is that where government can act purely as a leading-edge customer in markets with world-wide potential, then there is evidence around that says we do quite well and imported pharmaceuticals and the defence industry itself have been successful. On the medical point very specifically, I am encouraged by recent conversations that we had with the Department of Health who recognise that as a major purchaser of medical equipment, as well as of pharmaceuticals, they could perhaps involve industry more, not in the way of feather-bedding them, but in terms of seeing what the technologies that industry might provide are, and by possibly allowing the Health Service to be used as a test-bed for products and sharing the research agenda more with industry. That is something we would very much encourage. The boundary that we would draw is: beware of producing special-purpose products to local United Kingdom specifications that then do not compete in the world market place. The last point that I would stress and it is very important in the context of the White Paper, is that the DTI feels very strongly that there is no inherent contradiction between, on the one hand, having a good customer/supplier relationship but, on the other hand, driving very hard bargains with your suppliers. We also see no contradiction between scientific excellence and the relevance of that work to the market place. A lot of our strategy is to try and improve these linkages between the science base and industry or between government, as a purchaser, and industry at the research and development stage.

Lord Porter of Luddenham

87. As you know, we are talking about investment in the United Kingdom science base and you, Dr Robinson, have just said that we do quite well in this

[Lord Porter of Luddenham *contd.*]

country. There is not much money made in itself, is there? There is not much wealth creation from the science base. Is the wealth not made beyond that, in utilising the science base and, therefore, my question is: what is in it for us, so to speak? What is in it for us in encouraging input from overseas into our science base which is small money unless we exploit it also in this country? Perhaps we do. Perhaps there is a better chance of exploiting it in this country.

(*Dr Robinson*) Again there are a number of issues in there that perhaps I should try and separate. Firstly, as you rightly say, the science base does not have the responsibility of wealth creation. That is industry's job. Industry does not make money by exploiting the science base; industry makes money by developing products that sell in the market place. The science base is one, obviously important, but only one ingredient to that. Sometimes I think the whole terminology is very misleading when we talk about "exploiting" the science base to make money. We make money by developing products of which the science base may be one input. I think we should, if I may, Lord Porter, also recognise, as you say, that despite all our flagellation of this subject in the United Kingdom, we actually do quite a good job of academic-industry links. We do a better job than sometimes we realise. As to the question of whether we should be encouraging overseas companies to work with our science base, recognising, as it were, that the wealth creation will be in the company part, not the science base part, it does come back to this belief that if we are truly integrated into the world economy, then wealth-creation opportunities will come to the United Kingdom. Perhaps indirectly, but they will come nevertheless, if we provide an environment where wealth-creation opportunities flourish, one part of which is facilitating the working with the science base. Sometimes it is more immediate. We know of one example which perhaps I could quote, the Canon company, who set up a small research and development operation on the science park at Guildford. Their initial thinking was at this point to get access to creative thinking in the West. The thinking was so creative that they developed a whole new product line in loudspeakers. Canon has no history in loudspeakers in Japan, but their research patterns in the United Kingdom led them to loudspeakers. They developed a product line which is designed in the United Kingdom and manufactured in the United Kingdom, and if it proves commercially successful, eventually those products will be sold in Japan. Their manufacturing, certainly for the European market place, will be in the United Kingdom. So I think one does have to have this bigger picture and recognise that in the end, when you add it altogether, it is to the United Kingdom's benefit to be truly global.

88. Following again your statement that we do quite well on inward investment, would you like to hazard a quantification of that statement by putting us in the pecking order to a certain extent and what are the small countries whose industries have inward investment, who invest outward for the science base? What are the pecking orders between ourselves, America and Japan? Incidentally, if I may, could you just clarify one point? I must have got it down wrong. You said, I think, 13 per cent was from the USA and 4 per cent from Japan. Did you say that, in which case my question is where is the other 80 per cent?

(*Dr Robinson*) Let me answer the second part first. Those percentages were a total industrial investment in R&D in the United Kingdom. The 77 per cent is by United Kingdom-owned companies.

89. Of course, yes.

(*Dr Robinson*) That was total industrial R&D investment, not specific investment in the science base.

90. But of course the other investment is inward from the United Kingdom itself.

(*Dr Robinson*) Yes, from the United Kingdom itself. To answer the question as to the United Kingdom as a location for inward investment, let me answer with respect to the science base and then Mr Priston may care to add a comment with respect to industry in general. I think our evidence, which is largely anecdotal because nobody has to collect any of these statistics, is that the prime overseas location for investment in science is almost certainly in the United States, from other countries into the United States. When we have spoken to the Japanese, they draw the distinction between the American market, which they see more often than not as the leading marketplace in the world where they are to have a presence, and the European market as a major market that is different from the American one but not quite as advanced. So their instinct is almost invariably the US number one. At least when they talk to us—and, of course, they are very polite people—they put the United Kingdom as ahead of other countries in Europe where they would wish to invest and not far behind the USA, but, as I said in my introductory remarks, it is not that they see the United Kingdom as a long way ahead of European science.

91. The language is what counts.

(*Dr Robinson*) The language and the welcome is what really counts.

92. Probably one asset we have over America is we are the only English-speaking nation!

(*Dr Robinson*) I think it was someone more famous than I who said "two nations divided by a common language".

Chairman

93. Could I just follow that up by asking Mr Priston whether there is now an outward reach for similar investment in what are being called the "Asian Tigers", the Pacific rim and China, for example? Is this an area you are exploring?

(*Mr Priston*) Yes, indeed. We have obviously done our market research. The current wisdom, such as it is, is that the potential for investment from (if I could just include all of that part of the world) Japan is likely to remain depressed for a year or two, probably longer. There is not as much investment likely to come to Europe from Taiwan and Korea as some commentators have suggested in the last couple of years or so, for various reasons. We can only expect a handful of projects to come from those two countries and they may in fact possibly be overtaken by places

[Chairman *contd.*]

such as Hong Kong and Thailand and, possibly further along, Singapore and Malaysia. Most of the investment interest from the last mentioned countries is in joint venture and acquisition or setting up some kind of sales operation at the moment, but there have been, and there was indeed quite recently, a manufacturing investment greenfield from Singapore, so it is happening. It is all very small-scale at the moment. Could I add something to what Dr Robinson said about how do we rank in world order? To me R&D investment is a subset of a much bigger picture and perhaps I might leave some statistics that I have here in the form of a chart, showing inward investment projects by type. The red line at the top of this map—and this scale is compressed, I might add, so it is further up and there are numbers down the side—are manufacturing plants in 1986 up until 1992 and you can see there has been a bit of a dip recently, but it is well above all other forms of investment. The green line is the number of R&D establishments we have monitored as being established here. As Dr Robinson said, we may have missed some, but there is a tremendous disparity between the number of manufacturing investments which we have monitored coming into this country and those of other kinds, and I just make that general point. There is some evidence to suggest from the American investors who came here a long time ago, (the first was the Colt handgun company in 1837) that there is at least a decade or two between a manufacturing investment being established and the domestication of research and development activities and the typical period appears to have been about 25 years. The Japanese have accelerated that process for all sorts of reasons, partly political, partly pressure to improve their component-sourcing in this country which means that they do need R&D in the country if they are to do that. You cannot work with suppliers if you have not got your technology base, at least part of it, in the country concerned. The pecking order for overall investment (and I make the assumption that R&D will follow it in some way or other) is that we are second in the world after the United States for inward investment. In the period 1986 to 1988 the average inflow to the United States was 52 per cent of the world's inflow and ours was 13. That may sound very small but, at 13 per cent it was jolly nearly three times bigger than anyone else's. By 1989 to 1991 the US inflow dropped to 42 per cent of the total and ours had risen to over 28 per cent and we were still well over twice as big a destination as anyone else. The 1992 figures are not out yet. They come out in April, but our estimates are that we are probably round about 19 per cent and the US has dropped to zero and we suspect that other European countries, in particular France, are catching us up, but have not yet overtaken us in flow terms. In terms of stocks of investment, we are still way ahead of every other European country with some 37 per cent of all foreign-owned investment in the EC being in the United Kingdom. Of that, some 38 per cent is from the United States and a little over five per cent from Japan and, indeed, interestingly enough, the next three largest after the United States, are France and Holland and then Australia.

94. Thank you. That is very helpful. We will look forward to hearing the updated statistics. There is a technical point I would like to raise with Dr Hinder; are foreign-owned firms eligible for support from the DTI Innovation Budget and technology transfer schemes on the same terms as UK firms? And what do you think will be the potential benefit of the Technology Foresight programme in relation to the needs of inward investors?

(*Dr Hinder*) My Lord Chairman, no, foreign-owned companies, that is those from outside the EC, are treated differently. The general rule for all the schemes which fall under the DTI Innovation Budget (which is now called the Innovation and Technology Support Budget), that includes technology transfer, is that only foreign-owned companies which have UK-based research and manufacturing facilities are eligible for support. That is provided that the work or research is carried out in the United Kingdom. That is one proviso. There is another, that any exploitation of results within five years of the work being undertaken takes place within the EC.

95. Dr Robinson, you wanted to add something?

(*Dr Robinson*) You asked a question about Technology Foresight, my Lord Chairman, and as a member of the Technology Foresight Steering Group then perhaps it is appropriate for me to answer it. I think the broad answer would follow what Dr Hinder said. It is perhaps secondary as to whether we are talking about a foreign-owned company, as to whether we are talking about involvement of and representation by individuals who are performing industrial research and development here in the United Kingdom. In that respect, we would expect overseas multi-nationals to be involved in the Technology Foresight programme at the extent to which they are involved in the UK industrial research and development activity.

Lord Perry of Walton

96. If I understood Mr Priston in his remarks, he was making the point strongly that investment in manufacturing plants preceded investment in research and development by some 25 years.

(*Mr Priston*) From some research done of American subsidiaries in this country that appears to be the case. It has happened faster with more recent investments. The Japanese have been faster than anybody. It is not quite clear exactly why.

97. But it is exactly the opposite picture that we got when we investigated biotechnology because there the investment in research and development is occurring everywhere with all the companies and when we asked them they mostly said that they did not think that there would be any manufacture in this country. They gave various reasons why they thought they would not invest in manufacturing plants in this country, largely I think determined by the fact that the social atmosphere towards genetic engineering was perhaps less friendly than it was in the United States. Does that apply any more now than it did before in other areas than bio-technology?

(*Dr Robinson*) I think there are two factors at play, if I may, my Lord. The first, which Mr Priston alluded to, is that the rate of research and development in manufacturing is increasing. If the Americans were coming now, as opposed to 25 years

[Lord Perry of Walton *contd.*]

ago, this time horizon would be compressed because the timescales of industry are very compressed these days. At the same time it is recognised that the innovative content of products is more important relative to what it used to be and so that explains perhaps some of the more compressed timescales. In response to the point on biotechnology, again, if I may, it is important to recognise that, certainly compared with automobiles and even compared with electronics, the research component of biotechnology products is much larger than it was in those other industries.

98. At the moment?

(*Dr Robinson*) At the moment. It is not clear where it will go in the long term, but at the moment the research component is very important and, to be honest, the volumes that you manufacture are relatively modest. Therefore, the economies of scale to be gained by world-wide manufacture are very large. Equally, one has to say that the significance to the economy of the manufacturing part of those industries at the moment is relatively modest. So it may be more important for us to be involved in that part of the process which adds value, than that part of the process which does not, and in biotechnology the value is largely in the R&D activity.

99. But in the long term it looks probable that the market will be very large indeed and to be in on the manufacturing side early would be very important.

(*Dr Robinson*) I think that is absolutely why the DTI takes the strategy that it is not for us to decide that research is more or less important than manufacturing. It is important for us to welcome inward investment on any part of that spectrum, knowing that eventually all those pieces have to stitch together and the United Kingdom should be in a prime position to take further developments, whether it is research flowing from manufacturing or manufacturing flowing from research. But if we take an attitude of "We are not interested in the R&D investment because the manufacturing is not here yet", I think we can guarantee we will not get either.

100. That is not what I was implying.

(*Dr Robinson*) I realise that.

Earl of Selborne

101. Can I make sure we understand precisely the concept here. While it is clearly desirable to have a match between research and manufacturing in many sectors, and we come back to the decline in the manufacturing base, as much as we would like it, we never will have a match and it is very important, is it not, to have a strong science base which will effectively be provided with a global manufacturing capacity for which you might get licensing in your company, but there is no requirement surely to match the science base which might be ahead of the field in this country to the manufacturing sector which may not for one reason or another be able to match that.

(*Dr Robinson*) I think that is the point I was trying to establish with Lord Perry. Who knows what the future profile may look like, but the United Kingdom position is that we would like to be in there now, with whatever the current activity is and if it is only research, so be it.

Chairman

102. May we then turn to the EC and I would like to ask you what you think about the EC policies to encourage siting R&D facilities in less developed regions and what about the story of INMOS? Following on that, do you think you see any virtue in the EC Framework Programme in relation to attracting inward investment in science?

(*Dr Robinson*) Again let me try and tease out the issues one by one. I think it is dangerous to over-link together what we might call social, structural policies with commercial and industrial policies. If I may just cite one of my own examples of trying to gain planning permission to extend my laboratory, I ran into debates about, "We have got enough developments in Hampshire. Why don't you put it somewhere else like the North-East?" I said, "As far as IBM is concerned, it is not Hampshire or the North-East; it is Hampshire or another country". We have to recognise the extent to which we can link those two things solidly together. The EC I think hopefully has increasingly recognised that the social and industrial dimensions need to be related but cannot be confused completely. On the question of EC ability to attract investment through involvement in EC programmes, I think again one has to recognise that the significance of any particular EC programme on the scale of a major industrial R&D investment is going to be very modest. So I think we would feel that no company is going to take a significant decision to come to the EC to invest in an R&D facility just to be involved in a particular EC programme. I think certainly the Japanese would want to think about the complete, bigger picture and if they wanted to invest in Europe for the reasons that I have given, then they will come and they will not just come for an EC programme. The story of INMOS I suppose is relatively well known, that the Government wanted to encourage the establishment of a semi-conductor facility in the United Kingdom. INMOS was the chosen vehicle. Depending how you want to look at the situation, it has been more or less successful. It has successful products and I admit to having been a customer of theirs in my former existence. In the end, one recognises that the world-wide semi-conductor industry is, and has been for some time, reconstructing and rationalising itself just because of the scale of investments that take place. It was part of that rationalisation process that Thorn EMI, the buyers of INMOS, decided in the end that they wished to sell it. In terms of the Government's role, the Government was obviously very instrumental in setting it up. By the time of the sale I think it was recognised that the future had to be determined on strictly commercial grounds.

103. When it was established, were they aware, though I am not sure the timescale is right, that TI in Bedfordshire, for instance, were already in the semi-conductor business?

(*Dr Robinson*) I would have to admit, my Lord Chairman, that was back in the late 1970s long before I had any awareness of the activity.

Lord Nelson of Stafford

104. I was thinking about this question of the EC from the other angle and that is the degree to which the EC science programmes could be important to the future of the science base and particularly their bigger programmes. We have been criticised in this country for not attracting some of the major programmes to this country and the associated establishments that went with them. I think we only got one which was the JET programme, and it has been said that that puts British scientists at a great disadvantage because they have to travel to somewhere in Europe in order to participate which presents difficulties, including the recovery of costs of travel, time and so on, whereas if it is based in this country, it is headed up by British scientists, and others have immediate access to it without the great costs of time and money. Are we being active enough in applying for major programmes to be sited here and attracting money from the EC for the major science base in this country?

(*Dr Robinson*) You worded your question specifically in the context of science and to some extent the science base, so the first part of my answer would be that actually the United Kingdom science base is very successful in winning research grants out of the EC. I forget the numbers, to be honest, but we are more successful than pro rata would indicate out of the United Kingdom science base. There is a successful operation in Brussels and I must admit I forget the name of the operation, but a certain Dr Alf runs it, and I forget his surname for which I apologise on his behalf, but he runs an effective operation of representing the interests of higher educational institutions and Research Councils in Brussels and the United Kingdom does do well. The second part of your question is about the major facilities and you mentioned JET and, of course, most recently Cambridge has won the European Bioinformatics Institute as a project and, indeed, the Medicine Testing Agency was won through the EC, which is another example. I think there is a swings and roundabouts question about the extent to which a significant rationale for European funding is that we do build these European linkages and, therefore, without wishing to be trite in any sense, the international relationships on the travelling is quite an important part of it. I would perhaps represent a view that says one of the problems the United Kingdom has is "will we be too insular?" and, therefore, having to go further perhaps has the advantages as well as some of the obvious disadvantages. The third part, and bearing in mind I come from the DTI which is far and away the biggest single contributor in terms of apportionment of funding responsibility for European programmes, our motivation is to get industrial involvement in European programmes, not specifically science-based ones. There again, as part of our own policy rethink, we have been trying to raise the profile of the effort that we put in to supporting British industry being involved in European programmes. Perhaps finally I might add in this context that many of the UK companies that I talk to are much more thoughtful about their involvement in European programmes. In some of the earlier generations of the programmes it was a case of, "there is money available in Brussels, let us go after it". Now it is a more thoughtful approach which is based on, in practice, "is that fundamentally going to change our business and if it is not, then it is a digression and we will not bother". I think part of the challenge that Europe has is to construct programmes which are well aligned to benefits that industry will get out of them, otherwise they run a danger that you almost alluded to earlier on, of creating a honeypot that diverts industry's attention from the true marketplace and that is not in any of our interests.

105. As long as they get sufficiently involved to make that judgement?

(*Dr Robinson*) Absolutely right. In fact, the words that we have used is that it is not our job to get UK industry into European programmes, it is our job to make sure that they are aware of the opportunities and if they wish to take advantage we might be able to help them. That is the way that we put it.

Lord Porter of Luddenham

106. I would be very interested to have your view on the importance of individual exchanges in the context of trying to encourage inward investment in R&D, the science base. You have been telling us about the very important contribution which is made by the DTI and Government bodies and that sort of thing. How important do you think are the exchange fellowships, the international conferences and so on between individuals? Do they play an important role in encouraging this?

(*Dr Robinson*) Yes, they are massively involved. We use a phrase, I cannot claim to be the owner, that technology transfer is a body-contact sport, and to some extent we have the same phenomenon in the research community. It is a body-contact sport and one of the problems, of course, is that one is never quite clear which bodies one is trying to put in contact with which other bodies. So a significant part of the DTI approach to science, technology and technology transfer is to increase the level of body contact. Dr Hinder's group has got what amounts to a fairly dedicated objective, "what are the ways in which we can increase that body contact", and he mentioned some of them. Our approach to relationships with universities is how can we increase the body contact. We see LINK as a body-contact mechanism, not so much a mechanism just for doing research. We see the Teaching Company Scheme as a body-contact mechanism and I think if we have any problem in this area in the United Kingdom, if I may continue the analogy, it is that we do not play enough body-contact sport in mixing and matching the industrialists and the academics in ways where they can actually learn from each other and develop their thinking.

107. And the academics and industrialists from other companies.

(*Dr Robinson*) That is part of the same equation.

Chairman

108. It has been said to us on previous enquiries, of course, that one of the problems that British industry has faced is that all too often even in science and engineering-based industries the people who are running the companies are not scientists, they are not engineers, but all too often are running them from a

[Chairman *contd.*]

financial base rather than from a scientific and engineering base. In comparison, what happens in Japan and Germany is often different? Is this a fair criticism?

(*Dr Robinson*) It is certainly a criticism that I would not wish to try and deny. Was that a good Civil Service answer? As everything else, we run the grave danger of tackling problems with slogans. There is no doubt that in the very rapidly changing financial circumstances we have had in this country for a long time, that the ability to handle money is actually quite important in industry. The more that we can get this stable economic and macroeconomic climate, the more that other skills will come to the fore, other skills that add value. I do think that we should not give a picture that says "engineers have the right to run companies", but I do think it is important that a company board does have representatives from those parts of its organisation which are both driving it forward and adding value. Again, if I may, part of our remit is to increase the mutual understanding between industry and the financial community and between academics and actually what it takes to run a business and make money out of it. The more we can do that, then I hope the objective that you allude to in your question will be achieved.

109. Thank you very much indeed. Is there anything you would like to add?

(*Dr Robinson*) Just very briefly, since this is more or less my swan song, I am here through a long series of events that started 12 years' ago in IBM when I said that there has got to be a better way in which our company can relate to the academic world than we have been doing. That led me into a piece of work now ten years' old which said, "What is the value added to the United Kingdom of IBM's research and development activities in the United Kingdom?" As far as I know, I have been focused on this problem perhaps longer than anybody else and after that there have been quite some significant changes in how IBM operates in the United Kingdom, but it is all of this form of there is a bigger picture into which each of the individual bits has to slot and there is no one magic answer that is going to get us there in the end. Welcoming overseas investment in whatever part of the spectrum we think is important. Thank you.

110. Thank you very much and thank you Dr Hinder and Mr Priston. Dr Robinson, who knows, we may be in touch with you again wearing a totally different hat.

(*Dr Robinson*) IBM has a good story to tell!

111. I think it is possible we shall be. Thank you very much indeed.

(*Dr Robinson*) Thank you very much indeed.

WEDNESDAY 16 MARCH 1994

Present:

Dean of Beswick, L.
McColl of Dulwich, L.
Nathan, L.
Nelson of Stafford, L.
Perry of Southwark, B.
Porter of Luddenham, L.
Walton of Detchant, L. (Chairman)

Examination of witness

DR ANDREW WEBSTER, Anglia Polytechnic University, was called in and examined.

Chairman

112. Dr Webster, may I say how pleased we are that you have been able to come along and see us. We are extremely grateful to you for the detailed material that you sent us in the form of papers and other commentaries, which Andrew Makower has very helpfully summarised for us. We know, of course, that you are a Reader in Sociology at Anglia Polytechnic University and Director of the S&T Studies Unit, which studies the commercialisation of public sector research. You, also, are aware that our inquiry into International Investment in UK Science means overseas investment in research, science, engineering or medicine carried on in the United Kingdom, whether for civil or defence purposes, and we are interested in investment from overseas sources—whether commercial or public sector and whether from within or outside the EC. With that preamble, would you care to make an opening statement, just to introduce the things that you want to discuss with us?

(*Dr Webster*) Thank you, my Lord Chairman. Good morning to everyone. It is a pleasure to present evidence here today in connection with this very important issue. I think, in very broad terms, what I would like to get across to the Committee are probably two main points, and then these can be explored more fully through the evidence that I have. I think, first of all, from the research that my unit has conducted over the last six or seven years now it is quite clear that corporate investment—whether it is overseas or from within the United Kingdom itself—in public sector research science, universities, or public sector institutes (government research labs and so on) is, generally speaking, welcomed by those who receive it, especially in the short-term. I think, on the other hand, the evidence that I have suggests that problems can emerge (although they do not always emerge) in the mid to longer term if the collaboration is poorly managed by all parties concerned. In these circumstances, I think, the exploitation of research, which is often what concerns people about overseas investment, is, in fact, low for both the provider of the investment and those in receipt of it, in terms of genuine returns to them. So host and overseas parties can often find themselves in difficulties because of poorly managed overseas collaboration. What we have in those circumstances (and it does not happen in every case) is rather than an exploited science—a selling of the British silver, as it were, overseas—is a science which can be, for those who are in those circumstances, unstable and destabilised, if you like, with regard to their mid and long-term prospects of securing their research activities in the future. So few benefits from that type of situation can emerge and I think, in that sense, the management of overseas investment in the science base is as important a factor as anything to do with its specific origin. That is the first question.

113. It has been said to us by a number of those who have benefited from overseas investment in United Kingdom science that one of the great advantages is that the companies concerned are taking a long-term look at possible exploitation, and are not concerned with immediate returns. They are much more interested in funding fundamental research which may lead to some return in 10 or 15 years, whereas they have said that British companies tend to be much more concerned with short-termism. Whether that is true or whether that is a justifiable criticism or not is a matter we are going to have to examine, but would you care to comment on that point before you continue?

A. Certainly. In fact, you have anticipated one of my other comments. This question of short-term/long-term investment is crucial in understanding what is going on. Indeed, the corporations I have explored in detail in the last three years or so have had a long-term strategy with regard to investment. They see themselves investing in basic and strategic science for their own purposes and for the universities—whatever it is they are working on. The problem can arise, however—not necessarily because of the immediate individuals that are involved, either from within the company or the academics involved—that changes within (and often these are transnational corporations) the strategy at the centre can lead to changes of policy towards particular types of research activity. It is that which has to be anticipated by those involved. Sometimes it is and sometimes it is not, partly, perhaps, because of takeovers or mergers leading to uncertainties for those involved. The good thing is that in all the deals I have explored there is always a five-year period in which notice is given for those who are considering termination of contracts. That period of time allows the members of the collaboration to find new partners with other corporations. Where that does not prevail then there are serious difficulties, particularly difficulties involved when the academic group may have a reputation of being particularly well-endowed through corporate investment and the government and research councils regarding them as people who should not have first bite of the cherry if the larger corporate endowment is removed. There is a long-term dimension to it. I think, with regard to

[Chairman *contd.*]

British corporations, there is a continuing process of investment in British science—perhaps not on this sort of large-scale type of linkage, although I would say that the corporations I have spoken to about this do have equivalent types of what I call strategic research alliances (and I understand you visited one of those last week) and they do have these sort of linkages overseas. There is a suggestion within the industry that the reason they do not establish such linkages locally in the United Kingdom of this long-term, major, multi-million pound, nature is because they have, if you like, exhausted the goodwill (if that is the right word)—the degree to which they can invest in British science and still secure good prices on the PPR Scheme—the Pharmaceutical Price Regulation Scheme.

114. So you are talking mainly about the pharmaceutical industry.

A. In this context, yes. I think, though, that the research that I have looked at shows that overseas capital investment in the United Kingdom science base is, broadly speaking, of a longer term nature, and I think that to that extent, whether it is corporations or, probably as importantly, British finance capital, they should be prepared to have a long-term investment strategy in British science itself, whether it is in the corporate sector or elsewhere.

Lord Porter of Luddenham

115. Can I ask about this PPRS scheme, because we keep hearing about this? I would be interested to hear just how important this is as a factor in overseas investment. Let me put it this way, suppose the whole PPRS scheme disappeared or was totally unfavourable so there was nothing in it for them, how much of our inward investment in pharmaceuticals would go?

A. If we take pharmaceuticals, I think it is difficult to put a figure on that. In one of the collaborations I have explored most fully, and I hope you will respect I will not be naming any names on this one, the PPRS scheme was seen as a vital ingredient in the board's decision to allocate funds, a large sum of money, to the United Kingdom rather than elsewhere. It was an important ingredient but it was not the only ingredient. The other way of seeing that is to say in broad terms what is the cost, if you like, and return on investment in the United Kingdom. The other aspect one has to consider in terms of corporate investment in the United Kingdom is the relative, compared with other countries, cheap level of salaries and pay and overhead charges which the British science base makes on not only local United Kingdom companies but overseas companies too.

116. If the PPRS scheme disappeared would we lose 50 per cent of investment in pharmaceuticals?

A. Very unlikely, I think, we would lose on that scale. If one looks at the major funders of pharmaceutical industry-based research in the United Kingdom, which has an academic dimension to it, operating as trans-national corporations I think they are particularly attracted to certain features of the United Kingdom which are independent of the particular question of the PPRS. I do have, if you will allow me to show it, an overhead which I have provided to the Clerk of the Committee which summarises the basic points which have attracted investment in the United Kingdom.

117. Thank you. You have answered my question by saying the PPRS is an important factor but it is less than half of the sum?

A. Yes.

Chairman

118. It has been said to us by people in certain pharmaceutical companies that if the United Kingdom Government were to move more rapidly towards greatly increased pressure for generic prescribing, as distinct from prescribing brand-name drugs, that would in their view result in many of them removing their investment from the United Kingdom. The other point they have made to us relates to the advantage which the United Kingdom has under the present arrangements of the Pharmaceutical Price Regulation Scheme which enables companies to include within their pricing a 20 per cent component for R&D whereas other countries, so far as one can tell, do not allow more than 15 per cent. If that were to be modified what effect do you think that might have?

A. I think that would have quite a significant effect in terms of the medium term strategy that they would adopt towards the British science base. It is already the case there is considerable investment both from British and other companies elsewhere, not only in production terms for cheap labour markets around the world but also in R&D terms. What were once cheap labour markets have now become established and recognised technology centres of research. The local comparative advantage which in a sense that overhead (*Slide 1*) suggests in the United Kingdom could be eroded within the medium, not the short, term by these fiscal and financial changes. I think, on the other hand, I should say that we should see overseas investment not as merely something which has to be understood in terms of the costs of that investment or the returns on that investment in the short or medium term. These corporations genuinely have an interest in accessing basic and strategic science and are prepared to pay for that and go through considerable difficulties in accessing it. There are considerable inhibitions, putting it another way around, on actually investing overseas in a country like the United Kingdom; a whole range of inhibitions which prevent many multinational corporations moving outside their own home country. If you look at the figures on investment, R&D investment by US multinationals is much higher within the US than it is anywhere in Europe or Japan. So I think one should be careful about exaggerating the degree of investment overseas by multinational corporations.

119. Perhaps you could then carry on with the case you wanted to bring to our attention?

A. What I would like to stress in broad terms is the way in which we have to see overseas investment as part of a strategy from both the firm's perspective and from the host institution's, the research organisation's, perspective. I have on this slide (*Slide*

[Chairman *contd.*]

2) summarised some of the contextual factors which shape the propensity to invest overseas by corporations. Corporations make decisions about investment in these broad terms: the need to access technological competence which they do not have locally within their own country; whether they are provided more cheaply elsewhere; the desire to use overseas sites to train and access new personnel; investment is useful for PR and prestige purposes, and I am sure you have heard that from a number of companies, and particularly that goes down well with Government; and from the research organisation's, university's perspective, universities have welcomed it because of accessing corporate funds which are not available elsewhere for equipment, and that is most important in all the collaborations I have explored; to replace the real reduction in state expenditure which I know you are aware of; and to provide a form of training for post-graduate students by having placements in those firms. The way you then meet those objectives as an overseas investor can vary considerably, and what I have looked at in detail are a number of different types of investment which have been made in the British science base by pharmaceutical and bio-tech related companies. The one I have spent most time on is that which is related to long term strategic research alliances between a single company sponsor and research groups. I have also looked, I should say, at something which you have asked in one of your questions, and that is what I have called co-locational collaboration, where one simply establishes as a company your own R&D group in a university site without any formal contractual relationship with the university: a department becomes available for occupation and a corporation moves into that department lock, stock and barrel, as it were, and perhaps deploys maybe 100, 120 staff there, and they will have informal networking links with the neighbouring university but not formal contractual ties. I have looked at those too. What one tends to find is that companies which favour this strategy, this co-location on a university site, believe they have greater control over their links with academia, greater control over their overseas researchers based in the university site, in terms of tying the work much more effectively and closely into their in-house R&D. However, a number of those co-locational groups have also actually been transformed into formal contracts of the strategic research alliance type because they have seen the advantage of building stronger links with academia, they have tested the waters locally as it were in a university department, and in London there are a number of key centres of that type in the pharmaceutical sector and you may have visited them. That is one strategy but it is one which is relatively limited.

120. Can I stop you again because some of us saw last week examples of three different mechanisms whereby this kind of overseas investment came. One was the Bristol-Myers Squibb investment in pharmacology in Oxford which had endowed a building within a university department. The actual control of research rests with the university department but with the right for any inventions to be reported to the company if it funded the exercise and for them to have a major share in the intellectual property rights. Secondly, referring to what you have just said, we saw another institute which is wholly-owned and managed by a drug company, Yamanouchi, but which is located in buildings close to an academic campus. Thirdly, we saw the Sharp Laboratory, which is a British company but, again, is a subsidiary of a major company in Japan, but has the advantages—being British—of being able to tap such funding as may be available from government sources. So those are three different patterns. Are there others, or do those represent, in a sense, the three different kinds of collaboration that one sees through overseas investment?

A. Yes. I think that is a very helpful summary of the different forms and configurations of this type of investment. Each of those has different implications, not only for the immediate, short-term relations with academia but in the longer-term. For example, if one takes the second of those, the Bristol-Myers/Squibb collaboration, that type of relationship is a relationship which, in some circumstances, is quite likely, because of the nature of that relationship, to lead to spin-off firms within the vicinity—much more likely than would be the case with the other two you describe. This is because, as part of the processes involved in developing basic/strategic research interest, there is often, as I am sure you are aware, an emergent technique, technology or methodology, which could be rapidly commercialised upstream at the research end of the spectrum. One of the ways in which that could be done is through a spin-off firm from the collaboration which is jointly owned by academics and the individuals in the corporation or by the university and the corporation. Quite a number of these long-term linkages have these spin-off firms. They tend to have limited growth potential because they are selling generic technology, which may now, of itself, have a very limited market. Nevertheless, there is a sense in which, in terms of employment purposes, there is a net gain which one or two of the other types of collaboration you have described are less likely to have for the home-based marked. We have to see, if you like, the circumstances in which these types of investments were established, and through understanding that we can understand the potential impact they have in the long-term.

121. Why did you pick up academic-industry relations as a personal topic of interest, and do you feel that overseas interest in United Kingdom science is concentrated in certain sectors? Clearly, we feel, from our evidence received to date, that it is in pharmaceuticals, electronics and, to some extent, biotechnology. What else?

A. To take your first question—how did I become interested in and what is the importance of relations—my own initial interest in this area emerged some eight years ago (and I will be brief, I will not recount eight years' experience!) when I was exploring the relationship (in the field of agricultural science) between traditional plant breeding and new biotechnology in relation to breeding. I was engaged in a study at the Plant Breeding Institute at Cambridge—as it was then. At that time, as you may recall (this is back in 1986), the Plant Breeding Institute was privatised—the first major institute to

[Chairman *contd.*]

be privatised. I was, therefore, intrigued as to the impact of privatisation on the science base in that context—how it shaped itself and what happened to those who were left, and so on. As part of that I became more intrigued in the way in which commercialisation of science takes place. That subsequently led me to look at the wider set of issues, and one can find considerable debate about this, both at United Kingdom and OECD level (and, indeed, at NATO level, where I have received some support), which stressed the long-term changes to the role of universities and, thereby, the relationship between the science base within those universities and elsewhere. (*Slide 3*) This is a series of points which the OECD itself has addressed about the changing relationship between academia and industry: that universities have become increasingly autonomous and playing a role similar to that of enterprises; that co-operation with other research institutions and with industry will be increasingly encouraged; that the scientific and technological infrastructure of science base will become more flexible and dynamic, and research and training programmes may change more frequently than in the past; and that contacts with industry will be on a longer term basis. In some sense, my research has been trying to explore whether those predictions which the OECD has recently characterised are actually borne out through the evidence. There is a degree of truth about those changes. I think one can see, for example, universities increasingly playing a regional economic development role; one can see the formation of new types of intermediary linkages between universities and industry, and one can see that universities themselves are beginning to commercialise their own activities, but this is very much within the margins of university practice rather than the wider parameters. To finish just quickly with your second question—where are the sectors in which one sees the vast majority of overseas investment?—you are quite right that the evidence that I have looked at in the last few years would highlight aerospace, chemicals/pharmaceuticals, electronic equipment and computing, including office machinery. The overall proportion of overseas investment in those four areas, not only in academia but in British industry, has increased steadily over the last 20 years.

Lord Nelson of Stafford

122. I would like to explore a little further the reference on your previous slide to equipment and the interests of the universities to attract overseas investment because of the equipment they provide. There seems to me to be a bit of an anomaly here which I cannot quite understand. First of all, one hears so often that British scientists go to the States because the equipment is so much better there than here. Therefore, it is surprising that overseas firms come here because the scientific staff is here—which seems inconsistent. Secondly, it seems to me inconsistent with what you say on your slide, because if the universities are setting out to be closer to industry and to attract industry work, I would have thought the first thing they would have wanted to do is see they are properly equipped to attract that work and, therefore, they would have devoted funds to see they were so equipped. Finally, on the issue of getting equipment from overseas, if they do get that equipment from overseas can they use it in attracting other work from British industry?

A. Those are very interesting points that you raise there, and I think your comments do reflect not your own confusion at all but, to some extent, a tension that exists with regard to the value of the role of the provision of equipment in negotiating these forms of investment from overseas. It certainly is the case that in order to attract overseas investment we need to be a well-equipped laboratory, but the key element that appears to be always the case is that the overseas investor is looking for good research scientists, which clearly can only be expressed with the equipment they utilise. One of the problems that British science often complains about—understandably—is that in research council grants, for example, there are restrictions on what they would like to have access to in terms of levels of equipment and levels of funding over a period of years. These corporations will provide considerably more and, if one likes, unconstrained forms of equipment (and how it is budgeted for) than will the normal routes that one goes through in order to secure funding for equipment. It is not so much the machinery per se, but the terms in which one can access that machinery. There is much greater flexibility, there is much less constraint on budgeting and there is much less constraint on accountability when one goes through large endowment corporations than there is when one is going through the research council—understandably, because the latter is using taxpayers' money and must account for that. So in a sense it is accessing equipment and being able to access equipment more easily which makes it more attractive. I am using the word equipment here as a catch-all because one of the other aspects which academics are particularly interested in is having access to compounds which corporations are screening in-house as a basis for new chemical entities. Sometimes those corporations will, with sufficient secrecy, provide that form of material equipment to the research groups themselves, and all the groups I have looked at have had access to compounds of that sort as long as they are prepared to remain secret about that material. So it is a broader type of equipment one is talking about here. Much of this research is very new research and equipment, almost literally in some cases a scissors and paste job, high-tech held together with string, and if you have been going to research laboratories you will have seen examples of that technology, that new methodology, that new research experimentation in-house in cloned laboratories which has been constructed from a new United Kingdom base back in their own in-house research labs. So the equipment is very new and very much being developed on the hoof, as it were, in this context, but the corporations will provide the money and if one needs something next week, it will come.

Lord Dean of Beswick

123. You did mention the first research centre which was privatised, the agricultural one. I think you will be as aware as anybody here that was the

[Lord Dean of Beswick *contd.*]

centre of rather rumbustious political argument at the time. I do not want to ask you a question with a political overtone but would you say from your experience that financially it has been a success, and academically in terms of research it has been a success? I have a second question: you did refer to the peripheral developments which have taken place in universities and at this point in time, you said, they are not very profound. Would you consider those steps to be in the right direction? I think you mentioned the turn of the century, what would you think the outcome would be by the turn of the century, having come down that road? Do you think as a nation we will have benefited or is it just an academic exercise?

A. To answer your first question about the privatisation of the Plant Breeding Institute in Cambridge, now that the dust has settled I suppose one can avoid making political remarks about it.

124. I do not want to embarrass you.

A. I think if one takes it in terms of economics, the simple capital benefits of that privatisation, there has been a net gain to all parties concerned, to Unilever who bought the original institute or the applied aspects of the institute—

125. Has it made more money available for research?

A. Unwittingly it did. As you may know, the extent to which the PBI was in the public sector was that it was a charity, a charitable trust, and therefore when it was sold the proceeds of the sale could not go to the Treasury, which surprised the AFRC and the Treasury at the time. The Public Accounts Committee explored this and there was some debate about what should happen to the proceeds, and the proceeds all went to the remnants of the public sector research group which was transferred to Norwich, and they have built fine glass houses and major research laboratories there and they have done very well out of it in that sense. So the British science base in plant breeding has not been adversely affected.

126. So that was an unintentional windfall?

A. It is the unintentional consequence of science policy, is the way I would put it. To answer your second question, in terms of the millennium and whether these trends the OECD predicts will become generalised, I believe that what we are talking primarily about is a rather hybrid animal in the future in terms of the role of universities with regard to enterprise and economic development. That is to say, those universities which are likely to be most important in stimulating economic development and playing a role in innovation and enterprise and providing new technologies for the future, are the very same basic science elite universities. If one takes Harvard University in the United States as an example of where this process has surprisingly gone, because Harvard is often seen as an academic research elite university and only that, Harvard sees that within the next ten years or so a third of its money will come from industry, a third from federal government and a third from other public sources, and that suggests a profile which is common across a number of universities in the United States, but they will only attract that funding because of the basic science they are doing. There will be, I think, a whole second tier of, if you like, more junior universities who will play an important local regional role in training and so on, but the wider innovation role is likely to be played by traditional elite universities, so they will form a hybrid role with basic on the one hand and applied on the other.

127. Do you think that will come here?

A. I think that will happen, yes, certainly.

Chairman

128. Is it your impression that the United Kingdom attracts more overseas involvement in its science base than do other scientifically developed countries—I think we can however exclude the United States? Is it the case in comparison to other countries of comparable size, that we are more successful in this regard than others?

A. Most certainly so. If one looks at those sectors I mentioned earlier, the principal four sectors, which attract overseas investment, the same sectors are the ones which attract investment in France, Germany, within Europe; if one looks at the French and German figures you will see they are the sectors which also attract overseas investment. But if you look at the United Kingdom figures within those four sectors, when one puts together industrial science and the science base in the context of academia, the figure is roughly twice that of the equivalent sectors in other countries in Europe. So the United Kingdom is attracting twice the volume of investment for those four sectors. So we are very successful.

129. The more we fish in this pool the more interesting information we seem to obtain! Looking at the evidence we have just received from the British Council, there is evidence in that document of investment from overseas in a whole series of different areas of which I must say I was personally quite unaware before reading the document.

A. That is right.

Lord Porter of Luddenham

130. I was wondering about the title of this Sub-Committee—international investment in United Kingdom science—are they investing in United Kingdom science? After all, if I invest in Tesco's, I own a little bit of Tesco's, it becomes my own property and I get a dividend. On the other hand, I might have nothing to do with such investment, but I might go to Tesco's and buy something, buy a product or a service. My question is, are we not talking mainly about the second thing? Are these overseas companies not buying something rather than investing? They do not own a university department, it is not a long enough term investment that they are going to benefit in the longer term, so are they interested in United Kingdom science or are they interested in the products?

A. I appreciate the force of your question. I think the two are not necessarily mutually exclusive. By investing in United Kingdom science and having thereby a beneficial long-term effect from those in receipt of that investment, they also buy the goods it produces as well. The key question then is, on what terms does that process take place and who controls

[Lord Porter of Luddenham *contd.*]

the process. So one has to look carefully at intellectual property and intellectual property rights and ask whether the universities have sufficient control over that in these particular instances. You also have to look at the question of who is managing the process in real time as it develops, not merely the principle of investment but the actual process in real time. I have found different sorts of practices in the sorts of collaborations I have looked at.

131. If I may interrupt, what, partly, put this question into my mind was your reference to Harvard and the 30 per cent of Harvard's income. Those companies are not really investing in Harvard; they are buying products from existing university departments, and probably buying it at a good price.

A. But the return to Harvard in terms of licensing and royalties that it makes is quite substantial. The highest returns are to the University of California in the United States. In Stamford, in particular, we are talking here of hundreds of millions of dollars return on investment which has been partly initiated within the university but, also, is a reflection of the technological transfer, the investment that academics make with corporations. So they do have net gains from that for their own particular use. One has to say that that is not always the case. The notion that some British universities have, at the moment, of "Let's rush into patenting because we are going to make lots of money" is a misplaced ambition. The work which I am currently pursuing funded by the ESRC is looking at patenting activities in detail, and that work suggests that in terms of generating income for universities, there is not a strong or necessary correlation between the number of patents one holds and the actual licensing or royalties you can generate subsequently on the market. Many patents languish; many patents are not taken up for commercial use, so I think it is up to the universities to ensure that the terms in which its investment takes place provides them with that sort of return. Clearly, as you have seen in the Squibb relationship, one of the net gains Oxford has enjoyed is the building itself. The Oligosaccharides research unit in Oxford is another example of capital investment which, even if Monsanto pulled out tomorrow, would remain in place. So I think there is not a sense of running off with all the proceeds.

Lord Nelson of Stafford

132. If British science is so much more successful in attracting foreign investment, do you have any explanation as to why it is that we have been so unsuccessful in attracting the main European co-operative research programmes—of which we have only got one, which is the JET project. All the others have been sited elsewhere in Europe.

A. I am not sure I can answer that properly. The evidence I have with regard to attracting European investment in terms of EC funding for the science base is that it is higher than many other countries in the EEC itself. As I understand it from a recent conference I attended, EC research grant money to the United Kingdom—and, indeed, United Kingdom companies working within the EC—is actually one of the highest, if not the highest.

133. The work has been largely centred in Europe and not here.

A. That is not entirely true. If one takes, for example, the Esprit programme in IT, 25 per cent of Esprit grants for the last few years have actually come out of the total grants coming to United Kingdom researchers, which is a disporportionately higher figure given there are more than four members of the EEC. So we do seem to benefit substantially from EC research. The JET issue is something which I could not really comment on.

Chairman

134. There seems to be a feeling abroad that in EC terms it arranges distribution of such centres on a kind of rationing basis; that every country has to have one. That seems to be the way it is working out. Certainly we got the Medicines Control Agency recently, but I think Lord Nelson is absolutely right; at an early stage, where major research institutions were established, JET was the only one here.

A. The other one we have had recently is the one at Cambridge.

135. What is that?

A. The Sanger Institute for the European Database in gene sequencing. That was against competition from abroad. That is a major investment which is equivalent to JET in terms of the number of staff. That has come to Hinxton, just outside Cambridge.

136. Some of the papers we have had suggest that, leaving aside major institutes of this nature, almost 50 per cent of EC research grant funding has come to the United Kingdom.

A. As high as that?

137. Yes. Which is astonishing.[1]

A. That is astonishing.

Baroness Perry of Southwark

138. I want to return to the question of what is in it for the university, so to speak, and what benefit they have. Have you found examples (and I hope you have found examples) where it is not just a direct financial benefit that has come to the university in the building or the patent which they have been able to exploit, but presumably a spin-off of basic science? Anyone can draw a line and say "This is your applied science and go not beyond it", particularly if British universities are maintaining a balance between blue sky and applied science where the expertise is bound to be in the same area. Is there not an example of a sort of backflow from the applied, industrial-funded research into their basic research?

A. Within the industry itself, or—?

139. No, I am talking about the benefit now to the university. Let us assume a university is working on—I do not know—a kind of Harvard, 30/30/30, kind of basis. They have their own pure, blue sky research going on in a particular area; they then attract investment from overseas industry to do applied research in the same field. Do you not have

[1] See Q.144.

[Baroness Perry of Southwark *contd.*]

examples of where there has been a backflow from that into their own pure research?

A. I have two points to make about that. First of all, in general terms the comment has often been made to me by scientists I have spoken to through research that by going through the corporate investment route they can actually explore, if you like, more blue skies research—deeper blue, indigo blue skies research, if you like—than one can through the research council. The reason is because the terms on which they can undertake research are much less constrained in the early period; there is less sense of having to address the existing stock of knowledge, as it were. In the normal grant application one has to address the existing stock of knowledge, quite rightly, and one has to say how yours is going to contribute to that. There is, in a sense, a much more predictable trajectory of research; that one is filling out that particular paradigm puzzle. I have found that people who have been funded by corporations have actually said that in the early part of corporate collaboration they are much freer to follow their noses, as it were. The reins are off, to some extent, in that sense; there is much less reporting back to the agencies than there would be under the research council. However, I should also say that these corporations have substantial basic research laboratories themselves in-house, which are as good as, many would say, the university laboratories. So there is an interactive process on basic research. However, over a period of time it is clearly the case that some of the collaborations (because a senior member of the corporation is appointed to oversee it who has, perhaps, a different approach to this particular area of research) begin to come under pressure to apply their work in a way which will produce some technique or technology, or contribute to a product, or have some sort of benefit in a material sense for the company. This happens, from my experience, within four to five years of an open type of contractual relationship. It can create serious problems for academics when they are in that sort of relationship. What I have found from my research is that a much more appropriate and successful form of collaboration, in terms of foreign investment, which benefits basic and applied research and, potentially, has spin-offs in the United Kingdom, is a two-tiered system of investment by the corporation in the university. That is to say, to provide almost unrestricted core programme funding for a research group of staff, of 30 to 40 staff over a five to ten year period, but to have on top of that (as it were, piggy-backing on that) a series of identified research project areas which the company is interested in and into which people can bid for additional funds. There will be a two or three-year turn-round on that type of project. There are one or two overseas companies, in fact Anglo-American companies, which now operate on that basis. The beauty of that is that it ring-fences intellectual property rights which fall cleanly around these research projects and help to prevent leakage backwards and forwards.

140. You said one or two companies, have you found many examples of that two tier approach or is it relatively rare?

A. I have found that as companies have become more involved in the process and more sophisticated they have started to shift towards this. One of the questions you sent me was about the Sandoz/Scripps deal in the United States which caused so much furore, and it did so it seemed to me quite rightly because Sandoz seemed to me not only to be having a bite of the cherry but swallowing the whole tree in regard to the way it was trying to access federal funded research beyond the Scripps Institute itself. I am not sure whether you have seen the terms of that particular contract but I have provided evidence to Andrew Makower about that. The re-negotiated contract which is now happening and which is expected to be in place by June of this year, will be one which is more of this two track, two tier type of relationship, core programme funding and then specific research projects. I think it is ethically better as well for senior scientists and junior scientists involved in research to know where they have freedom to manoeuvre and where they have to be a bit more constrained, and I think it is practically better for managing that sort of process at the ground level. I should say though that it is then incumbent upon corporations themselves to recognise what they are doing when they put those sorts of things in place and to treat it with as much respect and sensitivity as they possibly can. I have found examples, which I will not name, where that does not seem to be the case, where there are serious problems of staff morale, of destabilising research, which have emerged, and that is what worries me most.

141. It is very much a matter of the sophistication of the company and understanding the relationship within academic institutions, is it not?

A. That is right.

142. The larger and more sophisticated companies with more experience are better at understanding it.

A. I think what companies need to do is to institutionalise that understanding. Thus far quite a lot of the relationships which have emerged have been dependent upon personal champions for collaboration within the company—the senior executive has a relationship of long-standing with Oxford or Cambridge and sets the deal on that basis. That is fine while that person is in post or does not retire, but if they retire there can be all sorts of difficulties which emerge. They need to institutionalise and build into that system beyond the personal forms of management which will help to see these things through. I am not sure they are doing that at the moment.

Chairman

143. That Sandoz relationship with Scripps in La Jolla in the United States was a *cause célèbre* and I gather that example has not been followed by anything comparable with other companies since that time?

A. No. Sandoz itself has a number of deals, it has United Kingdom deals and also in the United States (in Boston it had a deal recently with the Dana-Farber Cancer Institute in Massachusetts, 100 million dollars over 10 years), and this was the next step in the States in trying perhaps to some extent to

[Chairman *contd.*]

incorporate a wider science activity within its terms of collaboration, and it has had to step back from it. As a final comment on that, the National Institutes of Health has recently surveyed 375 industry-academic collaborations within the United States to see whether there were any more of these Sandoz/Scripps type deals and could not find a single one, so it is unique.

144. Can I clarify a point in case I did mislead you, I was wrong in saying it was 50 per cent of EC-funded research; however I was referring to the European Community's Third Framework Programme for research and technological development. The ODA told us that United Kingdom universities are participating in just over half of the projects accepted for financing from the first two calls for proposals, and in half of these it is the lead co-ordinator. "First call 83 projects; United Kingdom participating in 40 projects, 23 as co-ordinator. Second call 58 projects; United Kingdom participating in 32 projects, 13 as co-ordinator." So in that technological programme we have been very successful.

A. Yes, that is a particular technological programme which has certain features in it which are strongly represented in universities in United Kingdom science, which is why we have had so many co-ordinators and contractors on that programme.

Lord Porter of Luddenham

145. One has to be careful on this, Chairman, because it is "participating in", and one of the rules is you must have at least two collaborators from two other countries, so you have to multiply the figures by three almost.

A. It is certainly the case that United Kingdom scientists are co-ordinators disproportionately across Europe for these projects.

Chairman

146. Going back to the question which was raised by the Sandoz/Scripps issue, we have questioned a number of people as to whether there was any possibility that this inward investment in university departments, for example, might in some way distort priorities within the universities concerned by, as it were, attracting a disproportionate level of investment in certain areas. Those who have talked to us seemed to feel that was not the case, that in fact it had the reverse effect, that it had stimulated interest and had encouraged others to do something similar. The question really is that since current Government policy appears to welcome inward investment in all forms, would you feel that an unqualified welcome with the constraints to which you have referred should be the appropriate policy response?

A. The first part of your comment is interesting because I have recently published a paper on this question of what I call the research agenda and how that has been shaped by collaboration, and whether new priorities are being set and so on. It is a thorny question. It is certainly the case that new areas are opened up for research which perhaps have been on the back-burner—they were there but there has been under-funding—but it is also the case that over a period of time there is, putting a positive gloss on it, a coming-together of university scientists and corporate scientists to pursue a specific aspect of the research programme which is emerging. To that extent new priorities are being built into the science base which have an industrial user orientation, and clearly with regard to the White Paper that is to be welcome so long as, as is the presumption in the White Paper, the users are United Kingdom beneficiaries. To go to the last part of your comment, my belief is that overseas investment should be generally speaking welcomed in broad terms, whether it is in the private sector industrial science base or in the public sector science base, but I think it is crucial to understand the terms on which it is being introduced and whether there is a sense of stability, as it were, over a period of years about that form of investment. You can build stability into this form of investment in different ways—stability over intellectual property, stability over whether spin-off firms can emerge from those sorts of contracts, stability over the core programme funding research which needs to be sustained in the future. Where one has instead a set of priorities which companies may change over a period of years, because of changing management strategy, because of mergers, because of new regulations at national and international level, which change what the corporations see as being the right thing to go for (take for example Monsanto's problem of BST in Europe), those sorts of factors can have severe, damaging effects on the immediate local groups which are being invested in pharmaceutical corporations, and it is that which concerns me, not so much overseas investment itself. That would be my general philosophy.

Lord Porter of Luddenham

147. You seem to be saying that overseas investment in the science base is good for the universities. What about the other side? What about British industry? If more and more investment comes from industry overseas and they are benefiting from it presumably, otherwise they would not do it, is British industry losing out?

A. They will, if they find that the form of investment (and this is to repeat my last point) excludes them. Sometimes it does. In one or two deals I have looked at—not merely in the United Kingdom but the United States as well—it is quite clear that the terms of the investment will exclude a research group or an individual research scientist going to another company and saying "We have got this idea, can you fund it?" The normal comments that are made by sponsoring companies are "We do not prevent people from doing that because they can go to anybody, as long as they are not a competitor to us". Of course, major corporations are all competitors to each other, so, to that extent, it does not mean anything in practice. I think one has to ask oneself, first of all, what is the level of investment in group—is it 10 per cent, 20 per cent, or 100 per cent? As you get towards the higher end of that scale it makes it much more difficult to access and to draw on funding from other companies, because the sponsor is not going to see you go to a competitor. At the lower end of the scale (and some of the collaborations in the United Kingdom range from 20 per cent up to 60 per

[Lord Porter of Luddenham *contd.*]

cent of a group's funding)—20 per cent—that was built into the contract in order to prevent what you describe, so that the senior scientist who initiated the collaboration actually said to the sponsoring company (and the sponsoring company was prepared to accept this) "No more than 20 per cent of my group will be funded by you, and we can go to other corporations as well". And they have done.

148. The problem we have all been told we are facing for some time now is that British science is very good but it is taken up by overseas firms. This policy now, which is strongly supported by the government, seems to be encouraging that further.

A. I think that is right. The problem, as I understand it, is not so much the science base (which is relatively healthy, despite other things), it is the manufacturing technology base in the United Kingdom and how the science base relates to that. That is what the White Paper is trying to address. But it seems to me that our manufacturing base is declining, in the last 15 to 20 years, dramatically, as a contribution to GDP—whether that is leaner and, therefore, fitter is a political point, I guess. I think it is very important that we do not use the argument that British manufacturing is weak in order, thereby, to say we should close the doors to overseas investment. The two are slightly different processes. I think overseas investment can help to sustain the British manufacturing base and renew it, as the recent debate about Rover and Honda and British Aerospace indicates. We operate in a globalised economy and, in a sense, in a globalised technology too, and we have to be able to manage that as best we can within the United Kingdom and accept that there are going to be circumstances in which multi-national United Kingdom corporations are not going to invest in the United Kingdom and actually invest overseas. It is not really a question of "UK Ltd" versus everybody else, but of large corporations and how they orchestrate their affairs that we have to address—whether United Kingdom or other countries.

Chairman

149. Of course, it is a somewhat different issue because it was examined by the Sub-Committee looking at priorities for the science base and also by previous Sub-Committees. One of the difficulties appears to be shortage of venture capital and the availability of capital to exploit inventions. For example, we no longer make CT scanners in this country and we no longer make electron microscopes—some such things we made were very good, but the exploitation, marketing and development of these things just did not succeed.

A. That is right, but there is some hope on that front, as I understand it. I think this is a relatively recent development, so I am not sure of the detail, but as I understand it the Stock Exchange has changed its rules with regard to the terms on which corporations can go public, to the extent that the investment in those corporations as they go public is now more attractive to venture capital companies in the United Kingdom. This has come up in the context of dedicated biotechnology companies, as you may know, which have had a rather rough ride in the United Kingdom in terms of venture capital and have often had to go overseas—particularly to the United States. A recent report by Arthur Anderson suggested that the terms will improve venture capital in the United Kingdom because of these changes in the rules and regulations on the Stock Exchange. So I am hopeful that that problem will be resolved.

Chairman] That will be very helpful.

Lord Nathan

150. I wonder if I could pursue that line of thought. The effect of overseas investment in universities appears to bring scientists of the universities in quite close touch with what are very effective commercial entities. To what extent do you think that fact could be a good influence in relation to the exploitation of those inventions of theirs which are not locked into the foreign investor but would be available for United Kingdom industry?

A. I think it is variable, the benefits of that type of exposure, to overseas investment. There are a number of studies that have been done of the so-called academic entrepreneur—why is someone particularly enterprising in linkage industry, and so on, in commercialising their activities? It is not necessarily the case that it is the personal, idiosyncratic qualities that brings about entrepreneurialism, it is much more likely to be—as research suggests—what location that person is in, in terms of the university's environment. One of the features that would encourage an enterprise culture in university science which benefited from exposure to overseas support or nationalism from firms is a fairly strong industrial liaison office and technology transfer management office within the university, which can help facilitate researchers to translate scientific discoveries into a commercial development of some sort. There are stronger offices in some universities than in others. Some have much closer relationships with their university staff than others, some deliberately do not have close relationships with their staff. If you take Cambridge University, for example, the University of Cambridge has, up until now (although I noticed recently an advertisement for a Director of Industrial Liaison, so they are moving with the times!) had very much a "hands-off" approach to entrepreneurialism within the university itself amongst its staff, yet many of those staff have had innovation and entrepreneurial activities. I think that is because University of Cambridge research groups are often approached on an informal basis. I think that the informality is as important as any formal collaboration between a company and a university group. In fact, colleagues of mine you may have received evidence from at Edinburgh—notably Dr Wendy Faulkener—have provided substantial evidence on the importance of informal links between companies and academia as a basis for enterprise. Exposure is good, in other words, but it has to be facilitated by the environment in which it is in; of itself it is not a sufficient condition to bring about benefit to the science base.

Chairman

151. Following on from what Lord Nathan said, I think that you are suggesting to us that there is no real evidence to indicate that international

[Chairman *contd.*]

investment is undermining the strategy of the White Paper to try and create wealth ultimately for the United Kingdom, but is nevertheless something that has to be kept under review. Do you believe that academic partners are charging industry the full cost of collaboration, or is United Kingdom public science funding subsidising industry? Thirdly, what about the arrangements for intellectual property rights and patenting arising out of developments funded from overseas in the United Kingdom universities?

A. With regard to the first question, there is—not only from my own experience but also from research that has been done elsewhere—considerable evidence that universities are undercharging for overhead costs, for example, that they incur. That is partly not surprising, given that one of the overheads I mentioned earlier on was the way in which costs in the United Kingdom were seen as relatively low compared with other countries, and part of that was because of the low overheads charged on companies. Indeed, there was a very well-documented report by SEPSU, and your adviser in the room here was closely associated with it, in 1990 which looked at overhead charging in universities and demonstrated there was considerable undercharging at that time. The figures that I have come across in terms of the pharmaceutical sector indicate that indirect costs per researcher in industry are three times higher than the same costs which are met in a university, so clearly corporations see it as a good return on their investment in terms of that particular cost. I do have some more information on that in my written notes. With regard to the question of intellectual property, most of the collaborations in the United Kingdom which I have looked at have a similar pattern with regard to intellectual property rights. There is an overhead (*Slide 4*)—it is slightly complicated—which summarises the routes which are taken on intellectual property. This is an example of an SRA. There is a whole series of hurdles and steps which one negotiates as you move from submitting findings to a sponsor and then whether the sponsor decides to take that up and commercialise it or not. The particular strategy which they adopt at that time will then impact upon or affect the university itself. Broadly speaking it is a sharing relationship on intellectual property rights. The university has normally the right to exploit its own research if the sponsor says after a period of time, often six months, that it will not pursue this any further, the university will then take it back in and rights will be reassigned from the sponsor to the university. Typically when that happens the university is likely to say, "We are not going to get very far with this particular intellectual property we have been given back because if the company has looked at it, it is unlikely there will be a commercial market" so they will probably leave it to languish. The most important thing I think with regard to intellectual property issues, apart from the notes I have provided, is that universities have to understand intellectual property as a portfolio, as a series of patents or a portfolio of know-how, which they must try to nurture and to some extent guard. As they collaborate with overseas companies some of that portfolio may be taken away by the overseas company for its own particular portfolio purposes. That is when, in a sense, the intellectual property rights are seriously damaged. It is not one patent which makes the odds, it is whether you have 10, 20, 30 patents in a particular area which is the crucial issue. I think it is important for universities to identify what they regard as a portfolio of intellectual property and to negotiate background and foreground rights with companies which are seeking to invest in it on the basis of the portfolio, so for example the company says, "We will go and do X with this particular research" and the university says, "You can do that but only on these terms so we can exploit this generic patent, for example, which is part of our portfolio elsewhere, either other companies or research councils or for us on our own." It is how you carve up the portfolio which makes it a vital thing or not, which is the crucial issue. It is crucial then that universities have decent intellectual property staff who can negotiate the right sort of terms with companies. It is not so much the contractual terms, which are common and which people say there is no problem about, and probably there is not, it is what happens to the portfolio of such property where the problem actually lies.

152. And most universities have a formula they apply in relation to intellectual property rights, with a certain percentage of royalties going to the university, a certain percentage to the inventor up to a certain figure, and a certain percentage to the company. Those on the whole work pretty well, do they not?

A. Yes, and universities are sensitive about the rates they ask, if you like. If you look at computer software collaborations, for example, they ask for much higher royalty rates because the return on them is much quicker, for example within 18 months you can have a product returning a licence, so in that context you might only ask for 20 per cent of royalties. For pharmaceuticals you might ask for 1 to 5 per cent of the royalty because of the long lead time in that case.

Lord McColl of Dulwich

153. Going back to this business of universities under-charging for overheads, why is that? It always has been so and it still is so, and it is the same in the NHS. Why is it?

A. There is a view held by a number of people, and one who is particularly well-placed to comment on this is Dr David Thomas of Imperial College who has this strong belief, that it is not a question of the universities selling themselves short with regard to industrial investment, but also selling themselves short with regard to Government investment. Despite the Treasury rules which require universities to charge full economic costs, the CVCP's own guidelines and the research council's own guidelines as to what costs should be charged are actually less than that. So in a sense there are different messages being given out to universities about what is a reasonable overhead to charge. I think they will tend to operate on the basis of historical practice and convention rather than actually getting hold of this issue and addressing those to whom it needs to be addressed.

Chairman

154. The CVCP's guideline was 42 per cent, was it not, for a commercial organisation? Stanford got into terrible trouble for charging 100 per cent.

A. Imperial College charges 120 per cent royalties on many of its collaborations, not all but many, and is seeking that other universities should try and secure similar rates.

Lord Nathan

155. There are really two ways in which you can protect an invention. One is to patent it and you get a public monopoly, and the other is to keep it secret. How far do you think secrecy is a route which is adopted? It will vary, of course, with the subject.

A. It varies by technology sector.

156. Indeed.

A. In the context of chemicals and pharmaceuticals, a patent is the preferred option. A patent can secure for you rights which are unlikely to be jeopardised and infringed by other people in that context. In the context of software and computer technology, not only are patents difficult to secure, because of the law on intellectual property there, it is the case that it is much more effective to rely upon know-how, tacit knowledge locally. So it does vary.

157. It seems to me this must be a significant factor in what you were saying about the whole set up.

A. There was rather a mouthful of a phrase used by a researcher some years ago who was looking at this particular question, called "the appropriability regime of intellectual property". This was an academic called David Teece. Teece argued we have to distinguish the appropriability, that is the extent to which intellectual property can be appropriated or corralled or exploited by a group, and distinguish it by technology sector, by the different areas of research which are being undertaken, and secondly by the degree to which those areas of research are forced to rely on complementary assets to make them run. So if there is a university which has a particular area of intellectual property and has a good appropriability of that and feels it can secure it for its own self, but needs a whole range of complementary assets to make it run, to that extent its appropriability is less than if it has perhaps a less certain degree of control over the area but does not need any additional complementarity to make something run. In those circumstances it is likely to keep that secret, to keep its know-how local, to keep its research activities tacit within its own context, because it knows quite quickly it has the local assets to develop that into a commercial product. So Teece's way of understanding this issue I think is quite a useful way of understanding the different factors at work.

Chairman

158. Time is moving on but there is one issue I would like to finish with, and that is the issue of post-graduate students and your views on the extent to which such research students from overseas contribute in the longer term to the exploitation of the country's science base. The British Council pointed out two areas in which there have been significant investment from Japan in United Kingdom science, and each of them was sponsored by a former British Council student who had come from Japan to the United Kingdom. Some other evidence has indicated clearly that those who have been trained at a post-graduate level in the United Kingdom subsequently on returning to their own countries often look towards this country for similar developments. We have heard about the Chevening Research Studentships, we have heard also about the Marshall ones for US students and also about the government's Overseas Research Student Award Schemes, or ORSAS, but there is evidence from the papers we have to suggest that a number of other countries are moving fast into this field in recruiting overseas students for post-graduate study—in Australia, in particular, there has been an increase of 230 per cent in the last two years. What are your views about the importance of this in the context of our enquiry?

A. Unfortunately, my views are that much more limited than I have been thus far because it is something that, as an issue, I have not had an opportunity or chance to look at in detail. If one looks at the overseas industrial investment in post-graduate training here in the United Kingdom it is very, very small. As a percentage of the total United Kingdom post-graduate budget, overseas industrial investment for post-graduate training is 0.7 per cent, which is just over £500,000, on an annualised basis—which is not to be sniffed at but, as a percentage of total funds, it is very, very small. I think what is particularly interesting is the way in which post-graduates who are parts of United Kingdom research groups being exposed to overseas companies then leak out, as it were (as a brain and technology drain), to the sponsoring companies. That can happen, and does happen, because universities see these corporations as being useful training grounds for students as well as for the companies themselves. I think that recruitment by overseas companies of post-graduates through their investment is still very marginal. Recruitment is very secondary to what they see as being the value of this particular type of activity, because they often locate their own employees in these co-locational deals or SRA deals actually at the university and there is not, in that sense, a necessity for drawing out, through post-graduate recruitment, information from the group back into the in-house company.

159. Is there anything you would like to add before you go?

A. I do not think so, my Lord Chairman. I hope that the additional notes I have provided will answer any further details questions that you might have.

160. Dr Webster, we are very grateful to you for coming and thank you for a very interesting session.

A. Thank you.

Slide 1

Reasons higher overseas investment in UK:

- Supply of qualified scientists and engineers
- Links possible to wider scientific network via University collaboration
- Lower labour costs
- Fewer language barriers—especially for major TNCs from the US

Slide 2

Reasons for Overseas Collaboration (European context)

From Firm perspective:

- Need to access technological competences not available locally, and provided more cheaply elsewhere
- Desire to use overseas sites to train/access new personnel
- Investment useful for PR/prestige purposes

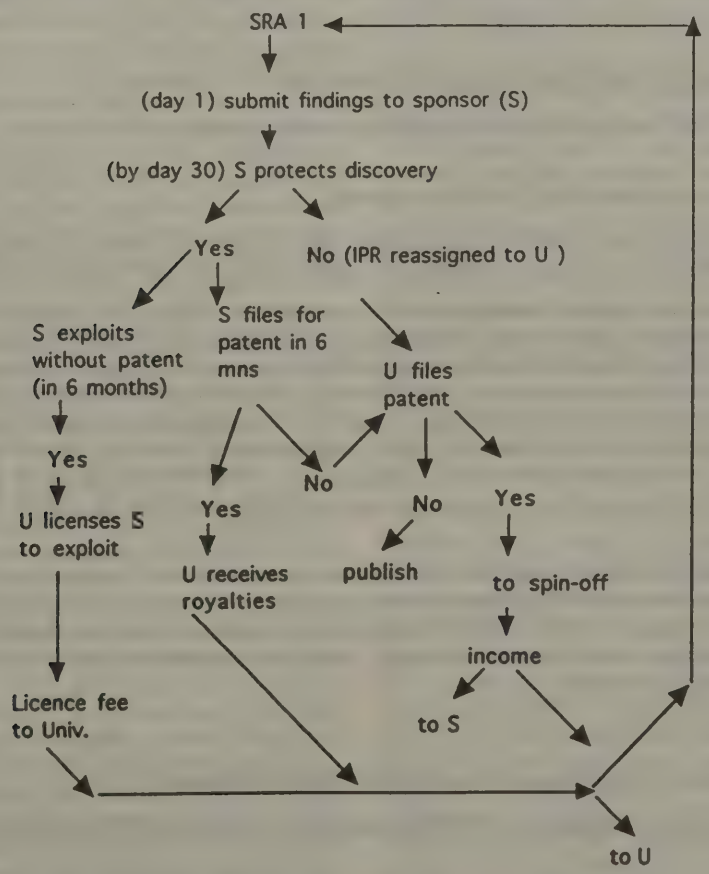
From Research Organisation (University) perspective:

- Obtain corporate funds not available elsewhere for equipment
- Replace real reduction in State expenditure
- Post-graduate placement in firms

Slide 3

- — the universities will become increasingly autonomous and play a role similar to that of enterprises;
- — co-operation with other research institutions and with industry will be increasingly encouraged;
- — the scientific and technological infrastructure will become more flexible and dynamic: research and training programmes may change more frequently than in the past;
- — contacts with industry will be on a longer term basis

Slide 4: Decision-tree on IPRs



WEDNESDAY 23 MARCH 1994

Present:

Dean of Beswick, L.
Nelson of Stafford, L.
Perry of Southwark, B.
Porter of Luddenham, L.
Selborne, E.
Walton of Detchant, L. (Chairman)

Letter from Pfizer Ltd Central Research

1. *What is the scale and nature of your research operation in the UK?*

All pharmaceutical research in Pfizer is grouped into one worldwide division, Central Research, which operates out of four main centres in the US, UK, France and Japan. The operation in the UK is the centre for our European Operation and is directly responsible to the President of Central Research in our headquarters function in Groton, Connecticut, US.

The Sandwich organisation is the second largest of the Pfizer Central Research centres and, outside the USA, is the largest research centre of any US pharmaceutical company. It comprises all the scientific disciplines and supporting functions required to undertake the discovery and development of new medicines from the initial idea stage through to world-wide registration.

Total UK staff in Research is currently 1,250, of whom 34 per cent hold a first level degree and 31 per cent a higher (PhD) or a medical degree.

In 1989 we initiated a substantial expansion of our research accommodation from 300,000 square feet to give now a total of about 800,000 square feet of offices and laboratories.

2. *What is the history of your parent company's involvement with UK science?*

Any involvement has been almost entirely through Central Research in the UK.

3. *What relations do you have with UK academic science?*

We have links with about 25 British Universities and our annual budget for pre-clinical grants and consultancies is currently more than £1.5 million per annum. This does not include any of our clinical grants.

In the science area, the types of funding include consultancies with senior academic staff, collaborative research projects, contract research work, post-doctoral fellowships and a chair at the University of Kent. We make six Pfizer Academic Awards annually, each of £6,000, to assist young University scientists in their research. We also award travel grants to permit young academic staff to attend international scientific meetings. Other additional payments include support of conferences, goodwill grants to university departments and prizes for posters and scientific communications. We participate in the SERC CASE studentship scheme, in the SERC/DTI LINK scheme and in the MRC Collaborative Awards Scheme. We also have an extensive programme to support and encourage the teaching of science in both primary and secondary schools.

In the clinical area, we have a number of consultancies with clinical staff in hospital and university departments. We also fund research agreements with specific university and hospital clinical departments for work related to our research interests. In some cases a registrar post is funded as part of the agreement. We also have a travel grant scheme designed to enable young clinical research workers to attend meetings to present scientific and clinical papers.

4. *What other international R&D operations in the UK might be contacted?*

I suggest that the major international R&D organisations which would be worth contacting are SKB, Roche and Merck.

5. The Financial Times Report

I confirm the comments reported in the FT of 13 December 1993 and have nothing further to add except to append a recent report from Scrip dated 15 February 1994, which reinforces many of the points. (*not printed*)

Peter S Ringrose
Senior Vice-President, Medicinal R&D, Europe

24 *February* 1994

Examination of witnesses

DR M ELVES, Director, Science and Education Policy Department, Glaxo Holdings plc, DR ROBIN FEARS, Director of Science Policy Analysis, Pharmaceutical R&D, SmithKline Beecham Pharmaceuticals, DR P RINGROSE, Senior Vice-President, Medicinal Research and Development, Europe, Pfizer Ltd Central Research, and PROFESSOR W DAWSON, Director, Technology Acquisition, Eli Lilly & Co, Lilly Research Centre, members of the Association of the British Pharmaceutical Industry, were called in and examined.

Chairman

161. Good morning, gentlemen. Thank you for coming. Of course, as you are aware, we are carrying out this particular enquiry in order to investigate the way in which money from overseas is contributing to research in British science across a wide field. We are not looking to investment in manufacturing industry, as such, but investment essentially in research and in the science base from overseas; the reasons why it is coming, the benefits that it brings and, of course, we must make it clear that this is something that, in general, is welcomed. We are, in no way, seeking to suggest any disincentives, but we have been concerned to learn that in certain situations it appears that overseas investors take what might be regarded as a long-term view, compared with many British companies. For instance, some of them are prepared to back long-term research which may not have any practical consequences for many years. It has been suggested to us that some British companies adopt a short-term attitude. I think we would exclude the pharmaceutical industry in general from most of these comments, it is in other fields, in particular, that these suggestions have been made to us. Of course, we are well aware of the very great contribution that the pharmaceutical industry makes to British industry. With that preamble, may I ask if each of you would be kind enough to introduce yourselves briefly, indicating what your specific responsibilities are in the organisation you are representing, and then follow that, if you so wish, with a brief opening statement before we get on to the questions.

(*Dr Ringrose*) Perhaps, my Lord Chairman, I could do the introductions because I am acting as a sort of Chairperson at this end of the table. Thank you, my Lord Chairman, for inviting us to participate in what we feel is a very important enquiry. I am Dr Peter Ringrose. I am Senior Vice-President for Medicinal R&D for Europe, for Pfizer Central Research. My colleagues are Professor William Dawson who is the Director of Technology Acquisitions for Lilly Research. Dr Michael Elves, next to me, is the Director of Scientific Affairs for Glaxo Holdings and Dr Robin Fears, who is Director of Science Policy Analysis with SmithKline Beecham Pharmaceuticals, is in the middle. Sitting behind us as an observer is Dr Jeff Kipling, Associate Director, Department of Medicine, Science and Technology for the ABPI. Dr Kipling will be submitting written evidence to this Committee at a later date. You will note that the team we have assembled for this meeting is a mixture of inward and outward investors in the United Kingdom science base and we will be able to offer the sub-Committee different perspectives on what we see as an important subject. The pharmaceutical industry, as you know, is one of the major investors in the United Kingdom science base, both directly and indirectly, through various contributions—financial and otherwise—to United Kingdom academic research, to medical schools and universities. The present enquiry is very much welcomed by the pharmaceutical industry which has, in the past, chosen to invest extensively in the United Kingdom. As you may also know, the pharmaceutical industry spent £1.5 billion on R&D last year in the United Kingdom, which is double that spent on research by the Government and charities. If the enquiry leads to measures that encourage inward investment, maintain the confidence of those UK-based companies to keep their research here and help to improve the United Kingdom science base, our time today will be well spent. As a group however, we have two major concerns. One is the increasingly hostile health care environment in the United Kingdom, as instanced by recently imposed pharmaceutical price cuts, price freezes, limited lists and proposals on generic substitution. The second is the declining science base in British Universities, which we feel is in dire need of major cash injection to keep it competitive with the rest of the world.

162. We appreciate the points that you have made about what you see as an increasingly hostile health sector position in the United Kingdom. Of course, it is one which is being experienced by many other countries throughout the world. It has been said to us by some witnesses that one advantage, as it exists, in the United Kingdom Pharmaceutical Price Regulation Scheme—which has led, in part, to the location of R&D facilities in this country—is the 20 per cent mark-up, allowing for R&D in the price regulation scheme, compared with the lower (often 15 per cent) mark-up in certain other countries. Is that a significant factor which has led to your company, or SmithKline Beecham or Eli Lilly, for instance, to invest in R&D in this country?

[Chairman *contd.*]

(*Dr Ringrose*) Perhaps if I could respond first. It is certainly helpful that we do have that allowance. However, it does not go far enough for a number of major companies in terms of the very large amount of R&D that we do invest in the United Kingdom. I would not have thought it was a major factor in terms of persuading us to come here in the first place and as a factor influencing our continued and future investment.[1]

163. Thank you. Are there any comments from Lilly?

(*Professor Dawson*) Yes. I would agree with the comment that it would not be a reason for us coming, but I think we would view it as beneficial because we are here. It is important to us that we have research in the United Kingdom and the PPRS scheme helps us in that. We do have the problem, of course, that if PPRS was the only scheme which was actually looking at our business, our investment in research, that might be helpful, but there are other schemes which get added to it from time to time and it is not easy to deal with PPRS in isolation, as at present constituted.

Lord Nelson of Stafford

164. I wonder, for those of us who are not so familiar with the pharmaceutical industry, whether you could explain a little bit more what you mean by this hostile environment.

(*Dr Ringrose*) What I was referring to there was that although we have learnt to live with the PPRS and are comfortable with it to the extent that we have a Pharmaceutical Price Regulation Scheme—

165. What does that do?

(*Dr Ringrose*) I am not an expert in the operation of the scheme, but I would be happy to leave an ABPI booklet with you in terms of how it operates.

166. And what is the net effect to you? Why is this disadvantageous? I am not really clear.

(*Dr Ringrose*) The net effect was originally to have been two-fold. One was to provide value to the NHS in terms of the drugs bill and the other was to sustain a R&D base in the United Kingdom. It does not do this, in fact, as the name implies, by price regulation but by profit regulation. As part of that profit regulation, there is an allowance for R&D which my Lord has just referred to. So it is that aspect which is potentially attractive relative to the situation in other countries. However, if that was the sole way of regulating profits within the pharmaceutical industry, this would not be so bad. What we feel is particularly hostile, at the moment, in terms of your question, is the fact that a number of additional measures have been brought in by the Government over and above the PPRS which are quite unnecessary and, in fact, undermine the operation of PPRS. These were cited at the beginning in terms of cost cuts (2.5 per cent in pharmaceutical costs); freezing price increases over the next few years; of the limited lists that have been widely discussed.

167. This is the action imposed on your customer, which is the National Health Service, presumably?

(*Dr Ringrose*) Yes. And, in addition, the current discussion on enforced generic substitution which could have a devastating effect on the United Kingdom R&D base.

168. And is this worse than is happening in other countries, or are they equally concerned about the costs of their National Health Services?

(*Dr Ringrose*) It is worse and different in the sense that no other country does all these things as well as regulating the profits that pharmaceutical companies can earn.

Chairman

169. And it is, of course, true, is it not, that even though prescribing costs in this country have been rising steadily—and there is clear evidence as to the reasons why that is the case, because there are so many new and effective remedies which have been introduced in the treatment of disease—nevertheless, the average prescribing costs by United Kingdom doctors are far lower than those by doctors in practically any other developed country in the world, and that covers the whole of Europe.

(*Dr Ringrose*) Whichever factor you use—whether it is the number of prescriptions per year or the cost for the patient per year—the United Kingdom is one of the lowest in the western world.

Lord Nelson of Stafford

170. May I just pursue one point because it is quite important. You refer to profit regulation. Who determines what the profit is on a particular drug? It strikes me that this is an extremely difficult thing to say.

(*Dr Ringrose*) I am sorry but I am slightly out of my field here.

Chairman

171. Is it not the case though that the Department of Health, in consultation with representatives of the pharmaceutical industry some years ago, came to an agreement on a certain limitation on profits in the pharmaceutical field? This was the basis of this PPRS scheme. Is that a fair summary?

(*Professor Dawson*) My Lord Chairman, let me reflect that the negotiations take place on a regular cycle, so that between Government and companies the overall scheme is negotiated by ABPI on the member companies' behalf; and then using the framework of that scheme, each company then looks at its individual costs, the profitability on its investment and—

[1] *Note from ABPI*: What the PPRS does in fact is to set for different companies, depending on the nature and breadth of their business within the UK, a ceiling on the R&D costs that they can claim as an allowable expense as a percentage of sales of goods to the NHS. It is not a fixed 20 per cent and can vary from the low teens to a maximum of 25 per cent. In fact for many companies their research investment in the UK may greatly exceed that percentage of sales which is accepted as an allowable cost. Since the PPRS is a profit regulation scheme, not an individual product price regulation scheme, allowable R&D costs are spread across the range of a company's products, and thus as a percentage of overall NHS sales. The ABPI does not have any data to hand for other EC countries on what level of R&D costs is permitted, but in all countries other than the UK negotiation takes place for the price of each individual product.

Lord Nelson of Stafford

172. That is the overall profit of the company? Not the profit on a particular drug?

(*Professor Dawson*) That is right. It is a package where the price regulation is across the whole portfolio of the company profit and it is up to the company to adjust its prices within the overall framework and to agree the package with the Government.

Chairman

173. I know Lord Dean wants to come in, but perhaps you would just tell us for information, what proportion of pharmaceutical companies in the United Kingdom are members of the ABPI? Is it the case that all the large ones are, and that it is only a small number of companies who are not in the first league, who are not members? Is that the case?

(*Dr Ringrose*) All the large ones are and about 95 per cent of the total.

174. I see. So it is a very small number who are not within the ABPI?

(*Dr Ringrose*) Yes.

(*Professor Dawson*) My Lord Chairman, there is a requirement that members have research and marketing and production within the United Kingdom.

Lord Dean of Beswick

175. Professor Dawson has partly answered what I was going to ask. Are you handed down a diktat, or have I heard you correctly that there is a form of consultation between you and your body and the appropriate body? It is not just a diktat from the Government? But when you say "consultation", are you ever in a position to say that you changed the Government's mind on some of its decisions because, very often, consultation only takes place when the Government has decided what it is going to do, which is not my idea of consultation. Are you placed in that position where you are consulting about something, but the decision has already been hard and fast made?

(*Professor Dawson*) I believe both parties come into the negotiations with a fairly strong view on what they would like to have and there is movement in the negotiations. I believe, at one stage, the Government did ask for rather less profit margins by industry which were not perceived as effective and so this was subsequently improved.

176. May I just come back for a moment? Let me hypothesise on something that happened in the past. Mr Clarke was the Secretary of State for Health. You suddenly saw the headlines, "So many million pounds reduced on the drugs bill at a stroke". Does that happen?

(*Professor Dawson*) In my view, no.

Chairman

177. Just again for clarification for Members of the Committee, your companies all, of course, have major investment in R&D and everyone accepts that the increased cost of brand-name remedies is one of the things which contributes to your ability to be able to carry out that R&D over and above the much lesser cost of generics. I would like to clarify the point in relation to generic substitution. There are companies of course—and many of them small ones—who may not be in the ABPI and do nothing except manufacture generic remedies. I take it that some of those do that when the patent life of the original remedy has expired. Are there others that do it under licence from companies holding the patent for particular drugs? Finally, do any of you, as major companies, manufacture generics as well as brand-name products?

(*Dr Elves*) If I can answer the second question first, as far as Glaxo is concerned, we do not manufacture generic compounds that have not, at some point, been patented by us in the past. One could take Ventolin, for instance, which is our brand name, but is now available in generic form as Salbutumol, and fairly widely available to health services of this country and overseas as well. So, in that case, yes, we would, if you like, be manufacturing what is now a generic compound. However, we would not, for instance, take one of Pfizer's or SmithKline Beecham's compounds that had run out of patent and manufacture that as a generic.

178. And the answer to the other question?

(*Dr Elves*) On the other question, the majority of generic manufacturing is done after patents have expired. Sometimes, of course, the generic houses begin the process before the patents have expired, but they cannot market until the patent has expired.

179. None of those houses do it under licence from the major companies holding the patent?

(*Dr Elves*) Certainly not in my company's case, we have not such an arrangement.

(*Dr Fears*) That is also true for my company.

180. So it is on patent expiry? What is that? After 17 years?

(*Dr Elves*) The patent expires now, of course, after 20 years.

181. I see, 20 years.

(*Dr Elves*) From patenting.

182. Yes, from patenting.

(*Dr Elves*) That is not the same thing as marketing.

Chairman] I understand. Thank you.

Lord Nelson of Stafford

183. You have said in another enquiry which we had into research in the pharmaceutical industry, that this country was at a disadvantage in the patent system in that the validity of any patent, at that time, dated from the time at which the patent was registered, rather than the time at which the drug was clinically proved and could go on the market, whereas in other countries the latter held. Has that been altered since that date?

(*Professor Dawson*) No, my Lord. Both the USA and Japan had patent term restoration before this concept was introduced in Europe. We could submit a paper on this. In addition, the United States of America has a scheme for patenting where you can swear back to the laboratory notebook to the time when the discovery was first made. They also give a term of 17 years from grant of patent, rather than from the date of filing the application for the patent. These things are not normally published for at least months after they have been submitted, so it would be possible for two or three companies to have a

[Lord Nelson of Stafford *contd.*]

similar patent on a similar series of compounds which they were developing simultaneously and would not find out about for at least twelve months.[2]

184. The important thing from the company's point of view is that the patent should date from the time they can exploit it on the market place which means after full clinical trials, is that not right?

(*Professor Dawson*) Yes, but I believe it is correct to point out now though that because there is considerable competition between companies to look for new molecules, then the time element between the United States system and the British system is not of such great importance as it used to be.

(*Dr Elves*) If I could add, my Lord, to that comment, it is probably a bit misleading to regard patents as absolutely central. Patents only give protection for the specific molecule that we are dealing with, or a broader class that our chemists can make at the time. That does not mean to say that we have 20 years' free trading or, often, even five years' free trading with that compound without any competition because medicinal chemists are fairly ingenious people. For example, in the case of our recent anti-emetic compound ZOFRAN we only had something like 22 months in that particular market-place without a competitor from our good friends at the end of the table, SmithKline Beecham. So patenting is not really a licence to exclusivity in a therapeutic area. It is simply exclusivity for that particular compound and class and ingenuity gets round that regularly. CIMETIDINE and RANITIDINE are very good examples of that.

185. But not quite so important as it might seem to be?

(*Dr Elves*) It is important, but we have to look at the innovative competition as well.

(*Professor Dawson*) I would say from our point of view, if I may, it is crucial to have a very solid patent because you are going to invest at least ten to fifteen years of development time and at least £150 million per successful compound. Unless you have a good patent you will not invest that money.

Chairman

186. Does your comment make it clear then that the patent which covered CIMETIDINE did not cover—

(*Dr Elves*) No, it did not cover RANITIDINE.

187. Even though they are both H 2 receptor antagonists?

(*Dr Elves*) Yes, there was a way through the CIMETIDINE patent.

188. Could the patent submission for CIMETIDINE have been drawn more tightly which would have had the effect of protecting against the other product?

(*Dr Elves*) That is, my Lord Chairman, what we aim for, but there is a limit to the ingenuity of chemists.

Lord Porter of Luddenham

189. If I may, my Lord Chairman, I would like to move now to the second difficulty which Dr Ringrose mentioned. I think he probably had something to do with the writing of this article as well from the Financial Times (13th December 1993) which we have. It says that you said, Dr Ringrose, "The UK is becoming increasingly unattractive to drugs groups" because of "the collapse of the science base, increasing Government interference in National Health Service drugs spending..." and the animal rights problem. We have been talking about the second one, but I would like to come to the first one, for the moment, because it is something which interests this Committee very much. We have just completed a study of the science base and, of course, we have heard a lot about it from the Office of Science and Technology and so forth. You said, Dr Ringrose, here, and it was pretty hard stuff, that "the attractiveness of the UK for drugs research was also being undermined by the dire state of the academic infrastructure." Then you go on to talk about the collapse and what happened in the 1980s. When you introduced it to us, you more or less attributed this (or mainly) to under-funding, I think. We all feel we would like more money, but when we accuse the Government and others of this we are told that the actual proportion of the GDP, which has gone into research over the last 20 years, is slightly increasing year by year and there are lots of other statistics of this kind. Also, we have been hearing that it is the science base of this country which is attracting so many scientists from other countries, particularly Japan, and to a certain extent, other European countries. So could I ask you, Dr Ringrose, or any of you, to tell me what is really wrong. Why is it in such a dire state? Is it just because there is not enough money? Why should there be more than there has been in the past, or is it spent very badly? Is it spent on other things? Of course, you will probably say right away, "Yes. Half of it is spent on defence," and that is true. But is it worse than it was really, from the financial point of view, or any other point of view?

(*Dr Ringrose*) Perhaps if I start and then I know my other colleagues would like to contribute on this. There are various ways of coming at this question and obviously it is very multi-factorial. Money is one component and based on the figures that I have been looking at, during the 1980s there was, in fact, a reduction of 0.2 per cent in the GDP assigned to Government R&D. By 1992, the Government civil R&D budget, in real terms, was £400 million less than it was in 1982/83. So, to me, those figures indicate that we have not even been staying constant.

[2]*Note by the ABPI*: The EC regulation on Supplementary Protection Certificates (SPC) for medicinal products entered into force at the beginning of 1993. This novel form of intellectual property, which takes effect after expiry of a basic pharmaceutical patent, will permit the pharmaceutical industry to be partially compensated for declining protection from patents, and thereby able to continue supporting its increasingly expensive research programmes, needed for the development of new medicines. The SPC derives its rationale from the steady growth in the time taken to research and develop a new medicine, both because of stricter regulatory requirements, and the increasingly complex nature of the research itself. In consequence, the duration of effective patent protection for pharmaceuticals has been declining. It is now about 8-10 years, versus the nominal 20. The SPC, the first of which has only recently been granted, is an attempt to redress this disadvantage and restore eroded patent time.

[Lord Porter of Luddenham *contd.*]

190. That is civil?

(*Dr Ringrose*) Yes, and that is at a time when there has been an explosion in new technology which can be instanced on a number of fronts, but particularly the human genome project in biological sciences. One can also look at the way in which British scientists are now motivated and how their output is judged on the world scene. Just to quote some figures here: the decline in the citation index, which is the number of times scientific papers are quoted by other researchers around the world, has declined during the last couple of years by just over 3 per cent, in marked contrast to Germany, the United States and Japan, where there was a net increase. That decline was most marked in the biological sciences and in clinical medicine.

191. May I ask about the point you have just made about the human genome project. I am not quite sure what the point was. You say that some of our money is going there, or are you saying that not enough is going there?

(*Dr Ringrose*) Some of the money is going there now. However, I use this as an illustration of the fact that there has been an explosion in new technology, particularly in the genetic and molecular sciences, and this involves a lot of expensive equipment for which a number of our universities are very poorly equipped. A lot of this expensive equipment is now increasingly only provided by industrial contributions.

192. But would you not agree that it is minuscule, the cost of that, compared with some of the grand fundamental particle project costs?

(*Dr Ringrose*) It is small, certainly.

193. Is it not that what is important is changing and that we must change where the money goes to, rather than the total.

(*Dr Ringrose*) But science now—particularly in the biological sciences and, to some extent, in the chemical sciences—is more expensive and more technology—and equipment-dependent than it has been in the past. This is a particular area where universities are suffering and are increasingly having to depend on contributions from the industrial sector. So that is just one component—the financial side. I think the teaching of science, the trends away from science in our schools, the low regard with which science teachers tend to be held—a lot of this contributes to the way in which the country is training and producing scientists of excellence that we, as an industry, depend on. It is our life blood to have a rich supply of excellently trained academic scientists coming in each year.

194. Mr Waldegrave is working on it morning, noon and night this week!

(*Dr Ringrose*) Just as another way of trying to quantify what I feel is illustrative of some of this decline, if you take the years 1960 to 1975, British universities produced 14 Nobel Prizes.

Chairman

195. You are speaking to one holder actually!

(*Dr Ringrose*) I am well aware of that, my Lord. From 1976 to 1991 we produced half that number. However, the interesting fact is that out of that seven only one came from a university, three came from the LMB, the Laboratory of Molecular Biology at Cambridge, and three came from industry.

Lord Porter of Luddenham

196. Would you not agree that that is very, very closely allied to a university?

(*Dr Ringrose*) It is, but even the gross number has halved over those two 15-year periods. There are various ways you can come at this question. I have given some examples, and I am sure my colleagues can add to those.

(*Dr Elves*) I would like to re-echo what Dr Ringrose has said about the quality of graduate we are now starting to see coming through into employment. A very significant number of them now, particularly in the biological sciences but the chemical sciences are not immune, have so little practical experience of the science or the art they are supposed to be practising, that we have now to invest quite a lot of time and effort in making them familiar with the laboratory, and making them safe to work in the laboratory. This is something we have seen developing over the last ten or 12 years, and is something we have got to be concerned about as companies. The other issue is the infrastructure of the universities. Quite apart from the large specialised equipment, I think even at the most basic level those of us who go around universities, in the United Kingdom and elsewhere, have got to be surprised, if not appalled, at the state of the laboratories that some of our scientists in our UK universities are being asked to work in, let alone teach in. Chemistry laboratories that I have visited really are still in the 1950s state, which we do not believe is good enough. There are some universities, however, who are shining lights—Cambridge is one and Birmingham is another—which have made a very positive decision to improve their chemistry infrastructure and have now got laboratories that are at least as good as industry's and, in at least one case, better than ours. There is a move to do something about it, but one suspects that a lot more could be done if decisions on spending at the university level were taken strategically rather than trying to be fair across the board.

197. The bottom line is that if things go on as they are you predict that international investment in our science base will decrease by the pharmaceutical industry?

(*Dr Elves*) I would not go as far as to say that because we do quite a lot to try and help the situation along, and I think we will continue to do that. Certainly as far as my company is concerned, we are committed to doing what we can for the public sector science base. We now offer 90 places in the company, for instance, for sandwich students, not only from the old polytechnics but also from some of the civic universities who are being encouraged to move in this direction. We feel that goes some way to bridge the gap and give these students some experience of an industrial and good laboratory environment. We have done quite a lot on supporting PhD students through CASE-type schemes and also through our own fully-funded PhD studentships schemes. We

[Lord Porter of Luddenham *contd.*]

have given up our attempt not to support infrastructure by major grants, and we have actually started putting money aside to provide major funds to universities for particular initiatives, and also of course for creating new academic chairs. One other aspect I would mention is the aspect of scientific discipline. In the United Kingdom and in Europe generally I think we are traditionally very strong in chemical sciences, biochemistry and pharmacology. We are not that strong in biotechnology, that is at the growing end of biological science. When Glaxo, for instance, wanted to get into molecular biology in-house we had an enormous job trying to recruit a significant number of competent molecular biologists to fill a new department. We eventually succeeded only because we happened to be able to buy Biogen in Geneva, which was up for sale. So we acquired an international group of molecular biologists that served our needs, and still does. We are a bit slow in the United Kingdom in getting into the newer areas and taking the opportunities that are there, although obviously there are a few exceptions, like monoclonal antibodies.

(*Dr Fears*) I want to endorse the comments made by my colleagues on the decline in the United Kingdom science base. That is not to say, of course, that there are not still centres of excellence, particularly in life sciences, in the United Kingdom, but on many of the factors that have been raised in terms of the metrics with regard to the impact of academic publications or the spend on civil R&D as a percentage of GDP, we share these views just expressed. Perhaps I could just make one additional point with regard to what we perceive to be a decline in education and training for scientists—and certainly I would applaud the efforts of Mr Waldegrave in raising the issue of public understanding of science. It seems to me that a lot of our problems with science education can still be traced back, before the university part of education, into the schools. We do not place enough emphasis on science at all levels of school teaching, I believe, and in particular I think some of us are concerned about post-16 education, where England and Wales remain the only developed countries to concentrate on so few subjects post-16. This has two consequences: inevitably it may decrease the pool available for entrants to universities, and also I believe it undermines the possibility of increasing public understanding of science, so few people are exposed to science post-16. I think we can trace a lot of problems back into schools.

Chairman

198. Thank you. I want to come back to that because I have recently chaired the Hamlyn Foundation National Committee on Education which has dealt with exactly some of those points.

(*Dr Fears*) Yes, these are not novel points.

Lord Nelson of Stafford] Just a quick question on the remark about not enough scientists coming forward with practical training after their academic training. That really is not the fault of the government, it is the fault of industry. I am inundated with requests, can I find a place for this young graduate or that young graduate to get some practical training, and the difficulty is to find places for them. That does not encourage other people to come forward if their colleagues are not able to get the practical experience they want.

199. Before you answer that, is it not also the point that there are certain academic courses in science in a number of universities, even some of the most prestigious ones, which are so narrow in their concentration on highly specialised subjects that the breadth of knowledge and experience that you require in industry may not be there in some scientists who graduate? Has the recent change in the organisation of the university sector overall affected this, or have you not had time to assess that?

(*Dr Elves*) I do not think we have had time to assess that. We always have recruited quite significant numbers of graduates from what were the polytechnics—the "new wave universities" today. Of course, the sandwich course system was very important in bridging that gap in training. I think the civil universities missed a trick there by remaining a bit aloof from that sort of higher education until recently. With regard to the question from Lord Nelson, I think when most of us were at university, as science undergraduates, we were required to spend quite a significant level of time in our university laboratories doing practical work and acquiring practical skills. It is that which seems to be missing now.

Lord Nelson of Stafford

200. The practical work in the universities?

(*Dr Elves*) Yes. That is what is going down now, and we have got to be concerned about the recent development in biological sciences to allow students to opt out of animal work.

Chairman] It is very proper that I should turn to a former head of a former polytechnic.

Baroness Perry of Southwark

201. Had I asked my question after Dr Ringrose had been speaking, I was going to say what are you, in industry, doing about the problems that you have raised, and I think Dr Elves did begin to answer that, but you talked about a reduction in government spending on civil R&D and there has been alongside that a very positive policy to try to encourage better collaboration between universities and industry and to bring a more practical industrial view, quite apart from money, into what is needed both in undergraduate courses and in academic research. I think really, despite Dr Elves' excellent range of suggestions, my question is still: is it not in part the reluctance of industry perhaps to interfere, and perhaps in quite a proper way, in what happens in universities, that is inhibiting you from putting in as much time and effort and influence and money to get what you want out of the academic system? I think you described it as your life blood to get well-found, well-qualified graduates and to get the kind of research collaboration that you need out of universities. Surely the answer is that you put more money, more time, more effort, more influence into what is happening?

[Baroness Perry of Southwark *contd.*]

(*Dr Ringrose*) We certainly do not feel inhibited and we certainly are not passive observers of this phenomenon, we feel very much involved and, as I mentioned earlier, it is essential to our survival and well-being that we do take an active interest in this. The British industry as a whole contributes in the order of about £50 million per year in terms of CASE awards, LINK schemes, grants, professorial chairs and that kind of thing, and I am sure my colleagues will back me up. A large proportion of staff within the industry lecture in universities, have visiting professorships, are actively involved on governing bodies of both research councils and university departments, so we take a very active interest in this. So far from it, we are not passive observers on this topic.

(*Professor Dawson*) I think it is two or three different strands, Lady Perry. I think there are now far more students who need practical training within the university sector and the funds are not there, nor are the facilities to train that number. ABPI have had discussions with the learned societies, the Royal Society of Chemistry, the British Pharmacological Society and the Biochemical Society and one of the topics has been the sandwich students. Now, there are insufficient places in the whole of British industry to accommodate the number of students who would like to do sandwich years. We just do not have the facilities to cope with that, although all of us take very many, as my colleagues have indicated. We also try in other ways and many of our staff go into both universities and schools to try to indicate some of the elements of the work that happens within industry. It is a really active programme to communicate the essence of the scientific disciplines, the practical nature of the scientific disciplines that we need. I happen to believe that if we want a strong technological base in the United Kingdom, it is inappropriate to reduce the amount of practical work within the university sector and I do not believe that that it is an industrial responsibility to fund that. I believe that it is infrastructure for the nation which should be provided by government. Now, for industry to try to work with government to do that effectively so that it is a partnership, I think that is fine, but it would require huge amounts of money to try to accommodate all of the chemistry students in the United Kingdom or all the biology students. There is certainly a trend away from practical tuition in our universities.

202. There is a more fundamental difficulty though, is there not, because the way government money is now, in my view, quite properly being directed is to heap up the excellence by putting money into the best of the research universities and that is not necessarily always the same as the best teaching universities. Now, if those are increasingly to be deprived of money for well-found laboratories, then surely there is a case there for industry backing up that difference as does happen in other countries? I was in Japan last year and Japanese universities for their undergraduate courses are teaching students on genuinely 1950s equipment, awful laboratories which would make the poorest of the polytechnics blush and when I asked Japanese industry if they felt there was a problem with that, they looked astonished and they said, "Well, no, we expect to train them on our own equipment when they come into their first jobs. The universities could not afford to keep up with the latest equipment and we would rather that they learnt the basic principles in university and sophisticated ones when they come into the industry". Is that not the way we have got to be realistic and start to move? We could not afford to keep every university with the number of students we have now with the best and most modern equipment that you have within industry.

(*Dr Ringrose*) I think that would be a very defeatist line to take. It is almost conceding that we are going to allow modern technology to pass us by and that is certainly not the case in the United States where there is a very real attempt to keep well abreast of modern science.

Chairman

203. There is also a fundamental difficulty, is there not, and that is that from your R&D budget, you will wish to put your money, even in equipment terms, into universities which are doing research and not into universities which are teaching the practical skills you are wishing to see, so there is a fundamental conflict there?

(*Dr Ringrose*) Yes.

Earl of Selborne

204. I listened with interest to the problems that you have identified within the science base which is clearly not performing as you would wish and what I would suspect you want from the science base essentially is well-trained, well-motivated scientists who can then contribute towards your companies. If, as you say, the base is diminishing and is no longer keeping up with the pace of change, could it not be, as Lady Perry has suggested in the form of her questions, that industry quite frankly is not playing its part? Professor Dawson tells us that even though there is an inadequate supply of research workers of the right quality coming out, you cannot even place such as there are at the moment in your sandwich years and it does seem to me that in the various comparisons you are making between the civil science base in this country and elsewhere that it is not so much the public sector we should be looking at, and I exclude here the pharmaceutical sector which is an exception in British industry, but we should be looking at the contribution from the industrial sector to complement the civil science base and it is that, I think, in all the comparisons we have found to be at the most stark disadvantage, and I wonder if Professor Dawson would like to comment on that.

(*Professor Dawson*) I believe it is certainly true that the environment in which we are doing business has changed I think the environment in which the universities are now working has changed and I am not sure that there is as yet a great dialogue to see if there are opportunities of doing things in a different way. Now, I think there may well be, but there would need to be government as a whole looking at the returns that companies are able to make to help fund some of this infrastructure because I can assure you

[Earl of Selborne *contd.*]

that in the present climate in which we find ourselves it would be difficult to create resource to try to accommodate an extra block of practical training for students at any level in a significant, in a substantial way, so I think there could be opportunities to discuss that. What worries me, I think, is that we are trying to have the whole of the student population prepared for something that not the whole of the student population is going to do and I would like to look at some degree of selectivity within the student population so that the people who want a practical career can actually benefit from the practical training that can be made available.

205. But is that not a very good reason why the training element which you are asking to be provided within the universities should in fact be passed back to industry because, after all, if a lot of these people are not going to be working in laboratories in industry, there is not a lot of point training them for it in the first place?

(*Professor Dawson*) I believe there is a trend now for more industrialists to be consulted on these matters. I believe we welcome that very much indeed, because we have a contribution to make. I think in the past it has not been easy for us to make that contribution.

Chairman

206. Do you have any contact, formally or through the ABPI, with the Council for Higher Education and Industry, which is one of the bodies looking at this? Secondly, the demands of undergraduate training in so many of the sciences now are so great with so many topics that need to be dealt with in many of these situations, might it be worth asking industry to put a lot more money into the funding of MSc courses to add that particular pattern of practical training which they require in their industries?

(*Professor Dawson*) If I could respond on behalf of the pharmaceutical industry, we do not see the Masters qualification as being a route that we are enthusiastic about. Other industries, other sectoral interests may see that, but we do not. I think that this is going to be an active discussion over the next few months. I do believe the ABPI, and member companies of ABPI, also take every opportunity to contribute to all of the initiatives that have been taken by for example the Sallers Chemical Education Group, including the survey that you did yourself. If we are asked to participate or if we learn of attempts to define the problem, we attempt to contribute our view.

Lord Porter of Luddenham

207. A very quick question on this matter of practical chemistry and practical work. I take it you are all saying that the pharmaceutical industry find on the whole their entrants from universities do not have enough practical experience. To me that would at first mean wet chemistry and so on, but they are spending just as much time in the so-called laboratories as they ever were. If you, like myself, go round schools now and see what they are doing in laboratories, they all proudly sit you in front of their computer. I wondered whether this is not just a shift from wet chemistry, which we still have to do, to the computer?

(*Dr Elves*) May I answer that, my Lord? Glaxo has been involved for some years with the Partnership Trust. We award a prize annually which, at the present time, is designed to encourage university departments to be more imaginative in the way they teach practical biological sciences. For the first three years of that prize I was one of the judges and we went around the institutions, ranging from polytechnics through to the civil universities, (and Cambridge was one as well), and what you are saying is absolutely true. They were using computer models, CD-ROMS, videos of demonstrations and all the rest of it as ways of avoiding practical work for large numbers of students.

208. I am particularly interested in your answers here because we are told increasingly that the future of drug research is computer drug design. My question is: do you want them trained in that now, instead or in addition, or are you able to do that when they come to your companies?

(*Dr Elves*) I think molecular design is still, and will be for a very long time, a highly specialised part of the medicinal chemistry activities that go on in the company. It can only ever be thus because, at the end of the day, the major emphasis is possibly on the wet chemistry and the medicinal chemist who can analog what his structural colleagues show him on the screen. That is a peculiarly chemical view as well, because we believe that equally important is the molecular biology on which that computer graphic science in turn has got to be based on. It is true, computer drug design is very much a part of where we are now going. I do not think we can define yet how important a part it is, but we cannot get away from the traditional type of chemistry, nor can we avoid molecular biology in understanding disease processes *per se*, because that is where we are still going to have to start.

Chairman

209. We have heard your comments about the academic laboratories in British institutions of Higher Education, and about them being no longer "well-found". You know, of course, that a number of companies have created special relationships with United Kingdom university departments, such as Bristol-Myers Squibb in Oxford, Eisai and Sandoz at UCL, and we have had many other examples. Do these relationships in practice in any way inhibit other firms which might wish to tap the resources of these departments, or do you find no difficulty in still tapping those?

(*Dr Elves*) As far as Glaxo is concerned, and I believe this is true of my colleagues as well, we have not found the relationships with UCL, for instance, or Oxford to be impediments in our developing collaborations with those universities. It has also got to be said, of course, that we would not attempt to get a collaboration that overlapped what the other company had already tied up.

210. You do, all of you, a great deal of R&D in the United Kingdom—why? I am not talking to Glaxo

[Chairman *contd.*]

but to Pfizer and Eli Lilly; and I suppose, Dr Fears, you are little bit of a hybrid because you are partly SmithKline from the States and Beecham from the United Kingdom originally.

(*Dr Fears*) Clearly, from that point of view, why we do some of our R&D in the United Kingdom has an historical connotation. I think our answer as to why we do R&D in the United Kingdom is the same as why we do R&D in the United States. There are two main reasons: one is the quality of science base in those areas in which we do R&D; and the other is the supply of well trained staff. Clearly, our commitment to continue R&D in any one place is affected by the factors we have already talked about.

211. Pfizer, of course, you have got European research centres both in the United Kingdom and in France. What do you get in France that you do not get here, and vice-versa?

(*Dr Ringrose*) Primarily all the basic research in Europe is done in the United Kingdom. The French laboratory is primarily for safety assessment as part of the development operation. The reasons why we have continued to invest in the United Kingdom, despite my comments about projections for the future, which do genuinely worry me, is that the United Kingdom still does offer an excellent base for not only scientists but also those trained in clinical medicine, and particularly in experimental medicine and clinical pharmacology. This provides an excellent continuum from the basic science into early development and clinical evaluation. Pfizer has recently opened up what we call a "phase one unit" or an exploratory medicine unit, at the Kent and Canterbury Hospital. We have Pfizer staff working within the hospital unit conducting volunteer studies, and that has worked very well for us as a company and also for the hospital trust.

212. We have been told that not only the quality of British science as such, despite your gloomy predictions for the future, is one of the reasons for overseas companies coming here, but also the structure of the National Health Service which makes it much more easy to carry out well designed clinical trials in the United Kingdom than in many other countries. Is that fair?

(*Dr Ringrose*) I think that has been the case. There are worries on that front in terms of the changes that are happening to hospitals now. Increasingly the amounts of clinical studies we have traditionally been doing just within the United Kingdom are more and more going out into Europe, because of the ease now and the quality of clinical studies being carried out in other European countries. The Sandwich facility for Pfizer is not just the centre for the United Kingdom, but also the centre for all of our European operations.

(*Professor Dawson*) I would like to agree with that. From Lilly's point of view we have had research in the United Kingdom for almost 30 years now, and the original reason for coming here was the excellence of British science and the need to tap into that—there is no question of that. We have stayed because British science is excellent and we would like to maintain those links. I must say, the numbers of centres of excellence is less now than it used to be. I believe that there are fewer of them because of the infrastructure. I think, whilst the good ones are excellent, our competitors in Europe are actually catching us up. Many of the European countries now are doing quality science, particularly in chemistry for example and in biological science in some areas, and the opportunities in those other countries are there to be taken. It is more expensive to do postdoctoral science in the United Kingdom than it is in any other European country.

Lord Porter of Luddenham

213. Why is that?

(*Professor Dawson*) The real costs are about £40,000 per year per post-doctoral person and that includes a 40 per cent overhead to the university, it includes the direct costs of salary and national insurance and it includes the running expenses for that year. A similar post-doc in France would be about £30,000.

Chairman

214. Why? What is less?

(*Professor Dawson*) I believe the best comment I could make is I think it is the way that the university infrastructure is funded by government. I think potentially it is that the overhead is less and that is certainly true in the United States where the cost of a post-doc is probably about £30,000 per year. My role is to look for science in Europe that fits Lilly's interests.

Lord Nelson of Stafford

215. But we are familiar with some American universities who are charging 100 per cent overhead.

(*Professor Dawson*) It is important to differentiate between contract research where it is expected that you would pay 100 per cent overhead and collaborative research where there is joint shared risk.

Earl of Selborne

216. I wonder if I could just pick Professor Dawson up on the number of centres of excellence. It does not, on the face of it, seem very surprising that if the cost of infrastructure increases exponentially, as it does, there has to be a degree of prioritising as to where the new infrastructure should be built. Do you necessarily think it is undesirable that there are less centres of excellence and is it not more desirable that these centres of excellence should retain the highest quality?

(*Professor Dawson*) That is a really difficult question. Most novel research ideas come from an individual, sometimes working in a smaller team and often benefited by a group structure, but it is actually an individual thought which is the new piece of information and I have some concern that if we drive exclusively towards centres of excellence, you lose the opportunity for individuals to show that initiative. I think there is a need to accommodate both elements in the end structure, but I certainly agree there is economy of scale in large groups and with reduced resource that must be part of the process, I think.

Chairman

217. Yes, but I think we would all take the point that you must not create a system whereby the young rising star who has real potential in research is going to have his or her potential frustrated and I think that is a very important issue.

(*Dr Elves*) My Lord Chairman, could I just give you a couple of statistics which I think will put the British science base in perspective in its standing certainly with us, and that is that in world terms the United Kingdom represents about 3 per cent of the market.

218. In pharmaceuticals?

(*Dr Elves*) In pharmaceuticals. In Glaxo's case because we are British it represents 10 per cent, and yet more than 50 per cent of our research is done here, so I think the amount of research that is done in the United Kingdom by the industry is out of all proportion to the size of market rewards we can expect, and that has to have something to say about the location and quality of UK science.

(*Dr Ringrose*) Perhaps I could just interject in terms of speed from the American company point of view and say that Pfizer again has about 3 per cent of its world sales for pharmaceuticals in the United Kingdom and yet we spend about 25 per cent of our total pharmaceuticals R&D budget in the United Kingdom.

219. Are any of your companies contemplating any change in location of your R&D facilities or any investment in countries other than the United Kingdom?

(*Dr Elves*) Can I answer that from the British angle? At the moment we are not because we have already broadened our International R&D activities but we have not actually relocated research resources necessarily. What we have done is develop new resources elsewhere.

220. Where, for instance?

(*Dr Elves*) We have got a major R&D resource now in the United States, we have also got major R&D facilities in Italy and we have got rather smaller research laboratories in Spain and France. In Japan we are developing, and we have got a relationship in Singapore with the University of Singapore and the Singaporean Government. These developments are really undertaken in order to take advantage of the very broad international science culture so that we can plug into that culture wherever it is and get the best out.

221. Is there any evidence that British-trained postgraduates from countries such as Singapore, for instance, are the kind of people that you may wish to recruit into these overseas facilities?

(*Dr Elves*) British-trained graduates, Singaporean natives?

222. Yes.

(*Dr Elves*) Yes, Singapore's education policy I think is a particularly good one and they do send their brightest youngsters in science all over the world to get training. When Glaxo created our Centre for National Product Research in collaboration with the National University and the Singaporean Government, we had very little difficulty getting high-calibre Singaporean graduates and post-docs to work in that Institute. We had gone into it with some trepidation, fearing that we might have had a problem, but we have not.

223. Have any of you any experience in other countries from which many postgraduates come for training in the United Kingdom, such as, for example, Hong Kong, Malaysia or other parts of the world?

(*Dr Elves*) No.

224. Many universities in the United Kingdom are becoming more active in managing and exploiting intellectual property rights. Are you content with this development and what do you feel about the IPR policy of the MRC and the other research councils too?

(*Professor Dawson*) My Lord Chairman, if I could lead on that one, IPR is crucial, as I indicated earlier, to the pharmaceutical industry and well-found patents are our life blood even though we clearly then need to reduce to practice and commercialise. University departments specialising in patenting are relatively few and far between and they tend to use agents. In our experience they can produce quite sound patents, but it is extremely difficult and expensive for them to defend , i.e. litigate those patents throughout the world and, therefore, our preference is invariably for us to control IPR and to pay license fees to the university, through royalties or whatever, to have a sensible negotiation to make sure that the university is not disadvantaged but the essence has to be the protection of the intellectual property, not really who owns it.

Earl of Selborne

225. But there are university companies now which do take it on and indeed we have had evidence from two such companies. Do you not think that it is valid for the universities to wish to exploit their own IPR where appropriate?

(*Dr Elves*) Can I answer that, my Lord. Because we are dealing with a very wide range of industries and sciences the answer to your question is going to be largely dependent upon the context in which we are talking. In terms of pharmaceuticals I believe that there is, by and large, not a good case for the universities to do the patenting for themselves because a chemical patent for a compound or a series of compounds, involves an awful lot of analog chemistry around the lead compound. Where we sometimes do get a patent which has already been taken out by a university for a compound, it has been very restrictive and in fact is almost useless because the compound itself is not the best compound to take forward as a medicine; yet the best compound is foreshadowed in that patent and, therefore, is not patentable in itself. So they can actually spoil the field for us. In the biotechnology field I think another issue arises, and I think a lot of the inventors are doing their own patenting, and we are running a serious risk of quite a large morass of small areas being hived-off, patented and requiring licensing before the industry can even exploit them as technologies. I think this is going to be disadvantageous to everybody at the end of the day.

(*Professor Dawson*) To go back to the point, it is important to understand, I think, that from our perspective we must maintain good relationships with the universities because they do produce new

[Earl of Selborne *contd.*]

ideas which we would like to develop. In our experience if you do a bad negotiation with a university, no matter who owns the IPR, it is very difficult to go back to that university and expect to get something out of them, so it is in everyone's interest to do a sensible negotiation. However, in practice we have found by experience that it is better for us to hold the intellectual property because our process of policing the patents worldwide and pursuing infringers is infinitely better than it is reasonable to expect the university to have the capability or inclination to do so. Plus of course we pay for it.

Lord Porter of Luddenham

226. Are there any difficulties in creating this liaison between a university scientist who has something better and you, in relation to your company?

(*Professor Dawson*) I think the answer is yes. It requires time to build confidence and trust between two partners. What we have tried to do as a policy is to start with groups in which we have common interests and have case studentships or small grants so that there can be a comfort built up between the partners and then you can move into a negotiation for intellectual property which is derived from that partnership. It does take time and it does need careful explanation of both sides of the argument, because there are two sides to the discussion. If you take time, I think my colleagues and I would agree, you finish up with structured licences which are comfortable for both parties.

227. It is a matter of developing personal relationships. There is no enactment of any kind?

(*Professor Dawson*) No, there is no substitute for personal contact.

Chairman

228. In your sector is there any relationship between the location of R&D and manufacturing, or do you tend to keep the two separate?

(*Dr Ringrose*) I think largely the decisions which determine where the manufacturing plant is placed and where R&D is placed are very different. The science base, as we discussed, is very much an important thing with R&D. With manufacturing at the moment within the pharmaceutical sector there is an over-capacity worldwide. The decision as to where one puts manufacturing to some extent relies on a trained labour force, but trained in a different sense to R&D people. Tax concessions and economics come into the argument a lot more for manufacturing than they do with R&D placement.

(*Professor Dawson*) If I may just add to that. If you consider differentiating between research and development, then the research units are rarely necessarily associated with manufacturing, but there is some commonality between the development operations and the manufacturing operations and they may go together.

229. What other measures could the British government, or the universities, take to make the United Kingdom a better location for R&D in the pharmaceutical sector, in order to attract more overseas investment, for example?

(*Dr Ringrose*) One of the points we discussed right at the beginning in terms of PPRS, if we continue with PPRS in its present form, if that is used as the sole way of controlling profits, then this would be a lot better than the system we have at the moment, which we feel is not a "level playing field" for us, particularly with recent announcements on generic substitution on top of the extension of the limited list. This sort of thing we feel generates, certainly from overseas companies, a feeling of a hostile and unsympathetic environment. I think there are things that could be done in terms of greater consistency of government response. The other one would be more government action involving a major injection of cash into both the teaching of science in schools and research in universities.

(*Dr Elves*) Could I just amplify on what Dr Ringrose has said about the PPRS and other schemes. On the whole, PPRS, we believe, is supportive of innovative research because it takes our expenditure on research and development into account in the formula. It is the bits that are added on around and about it which are the problem. They are not only a problem for us but, I would submit, they are a problem for the health service at the end of the day as well. The limited list, for example: by putting dermatologicals and contraceptives on to the limited list it makes them areas in which it is not worth carrying out research, yet about 2 per cent of the population suffer from psoriasis. It will make that sort of area an orphan disease, if you like, although very significant numbers of people are suffering from it. It can have a profound effect on our selection of therapeutic areas in which we choose to conduct our research, and look for drugs for the future. On the generic substitution, I think the real danger there is again one against innovation. Why should we spend a lot of money to discover and develop new medicines if the prescribers are going to be pushed in a direction of sticking with the old and often not very well trusted medicines, as opposed to the new medicines which might produce a quantum jump forward in treatment.

230. I think it is fair to say, however, is it not, that some of the remedies and dermatological preparations are in fact extremely cheap and in fact, if purchased by the individual on prescription, cost less than the prescription charge; that is perhaps being the devil's advocate. The other question I would like to ask you is this: are all of you involved also in OTC, over-the-counter remedies, or only some of you; if so, what proportion of your profits is coming from that particular sector in view of changes in the ability of pharmacists to be able to provide certain designated remedies?

(*Dr Elves*) Glaxo is not in that field.

(*Professor Dawson*) Lilly is not in that field.

(*Dr Fears*) SmithKline Beecham is.

(*Dr Ringrose*) And Pfizer is.

[Chairman *contd.*]

(*Dr Fears*) I am afraid I cannot provide figures today but I would be happy to give background details at a later stage.[3]

Chairman] It would be helpful to know because one would be interested to know whether the profits that you receive from prescribing in the NHS, with the constraints that you have mentioned, have been, in your two companies anyway, compensated for by profits on over-the-counter remedies.

Baroness Perry of Southwark

231. Could I just interject a question to Dr Elves? You are, all of you, in an international market and even if the United Kingdom's list makes it unprofitable in this country to invest in research in treatment for psoriasis, surely it is still worth doing research because there are other countries in which those particular conditions will be very different?[4]

(*Dr Elves*) That is a good point. Other countries tend to adopt the same sort of ideas, however. Skin is rather dull and boring.

Chairman] Except to dermatologists!

Baroness Perry of Southwark] And those that suffer from it.

Chairman

232. And the patients, yes.

(*Professor Dawson*) To the patients, definitely not.

233. Finally let us deal with animal rights terrorism. Is it a serious problem? Is it worse than in other countries and have you any ideas of what you can do about it?

(*Dr Ringrose*) Certainly in our view it is worse here than in any other country. There are no other countries in the world that I am aware of, even in the United States, where this lobby has been increasing, where one is subject to car bombs, razor blades in letters, letters that explode, all of which have all been happening recently. In addition a woman member of staff who was not directly part of the R&D group has recently been terrorised by these animal activists. This is unprecedented in other countries, so it is a phenomenon that we do have primarily in the United Kingdom. It is of course having an impact, as we mentioned earlier, on the teaching and training of pharmacologists and the willingness of universities to engage in animal experimentation. We feel quite strongly that the laws on aggravated trespass should be strengthened as part of the Criminal Justice (Public Order) Bill. Recently this has been subject to review in terms of hunt saboteurs, but in fact gives no protection against trespass on company property and the sort of activities which the animal terrorists will get up to. So I think there are things the Government can do in terms of protecting scientists from the acts of terrorism by these animal activist groups.

(*Dr Fears*) We do of course distinguish between the terrorism element and those who hold other views on animal experimentation and we are very happy to engage in public debate on our own behalf, or via the RDS. But indeed I think we all share the view that animal rights terrorism is a particular problem in this country and I would endorse my colleague's views on the possible way of dealing with that via the trespass law.

(*Professor Dawson*) We obviously would support that. It is a problem. Companies, by and large, will attempt to protect their staff effectively. I believe it is much less easy for the science sector within academia and they are equally at risk. In fact, the protection of the university structures is a significant problem. Universities are having to spend significant resources to do something about it which is unfortunate. I think it is sad, given the constraint of resource for good things, that money has to be spent to protect the pursuit of learning.

Lord Nelson of Stafford

234. Why is it that this country seems to suffer more in this field than other countries? Is it because our laws are too lax, or is it that we have got a bigger lunatic fringe, or we do not sell the thing properly? Why is there a difference between us and other countries, who successfully exploit this type of research?

(*Dr Fears*) I think in part I would ascribe it back to a point I made earlier with regard to the public status of science. We do not accord science with sufficiently high prestige, or priority from the education point of view.

235. I cannot see that could come into the minds of the animal activists?

(*Dr Elves*) We are dealing here with a number of very distinct issues. There is a general anti-animal experiment lobby who, by and large, are reasonable people and will hold their views and we will respect their views; we believe that they probably respect ours, although they do not approve of them. The real problem lies in the groups who decide to use this as an excuse for militancy.

236. This is rather my point. I do not think anybody would challenge the first. In fact in many fields, particularly the agricultural field, our approach to animal welfare is much better than it is on the Continent.

(*Professor Dawson*) Absolutely.

[3] *Note by ABPI*: Opportunities for movement to OTC status are limited by the number of indications which are suitable for self-medication. The position regarding the sales of OTC medicines is therefore variable between individual companies and the overall effect on the market is unknown. The effect may not be as significant as would be expected from the recent relaxation of prescription only restrictions.

[4] *Note by ABPI*: The reputation of the UK for high quality medicines and its rigorous controls in the regulation of medicines mean that medicines licensed and supplied to the National Health Service (NHS) are recognised throughout the world as of the highest quality, safety and efficacy. Denying a medicine access to the UK market by "blacklisting" it and preventing its use under the NHS will also effectively undermine its potential for success abroad. Many countries overseas are unlikely to purchase medicines which have been rejected by the NHS. In addition, the price of a medicine in the UK is frequently used as a comparator price by which it can be sold abroad. Efforts by the NHS Advisory Committee to seek to reduce the NHS price of medicines controlled under the Limited List can therefore have a knock-on effect in terms of reducing the potential price of such products.

[Lord Nelson of Stafford *contd.*]

(*Dr Ringrose*) In fact, the legislation for the protection of laboratory animals in this country is one of the tightest in the world. Part of it, in my view, is the fact that traditionally the United Kingdom is seen abroad as a nation of animal lovers, and I think also there is probably greater tolerance of the lunatic fringe in this country. If you go to Mediterranean countries there is very little sympathy, or even awareness, public consciousness, of animal welfare. It is partly cultural I feel.

Lord Nelson of Stafford] The conclusion to draw from that is that those people who fund this sort of thing choose to come to this country because it is more receptive, shall we say, which means we ought to tighten up the laws more.

Earl of Selborne

237. Chairman, I think we are touching on something here which is quite fundamental, back to some of our earlier discussion about the climate in which science operates in this country. I do not think there is any point in pursuing the terrorist side of this; they are beyond the law and beyond the pale; but I do believe that you have touched very correctly on a body of opinion which deserves much more serious debate and contact, and that is people who take the strongly held view that research in areas which affect animal rights is something which they wish to see limited or even banned. I think you would hear from Members of Parliament or people standing for election in the European Parliament in the next two months that they expect more correspondence on this one issue than anything else, which demonstrates just how astonishingly widely held these views are. Does it not put an enormous responsibility on biologists and other scientists to try and structure much better debate, particularly at the primary and secondary school level?

(*Professor Dawson*) Yes.

238. Is there anything that either we as a Select Committee or you in the manufacturing sector should be doing to advance the debate more efficiently?

(*Dr Elves*) Yes, if I might answer that. We have had a particular problem in Glaxo with our relocation to Stevenage where we are building a new research site. The animal liberationists targeted that operation for their particular attention and did whip up a lot of feeling in the general public in the Stevenage area. Our response to that was not to go into our shell, and pretend it was not there. We have now put in a lot of effort to take that debate out into the community and answer the questions that are being put to us. I believe that that policy is starting to have some success. You are absolutely right, of course, that the prime place we ought to be getting into is the schools because that is where a lot of the problems start. We have been particularly active in that area and it is probably as a result that one of our staff, who Dr Ringrose referred to, suffered a number of hostile incidents. She was specifically targeted because she was one of the leading lights in taking that debate into the wider arena and did it very well.

Lord Porter of Luddenham

239. I am very interested in that reply and sort of go along with it, but it reminds me of the fact that four years ago a group was called together of the presidents of the royal colleges and indeed the ABPI, if I remember rightly, and the Royal Society to discuss this very question of what could be done to change the public image or to promote the public understanding of the need for these experiments and so on and the final result was a total collapse in the sense that the conclusion was "Keep a low profile", that anything you do to try to help in this respect will be publicising what is going on and the research people themselves were the first to say, "Just forget it. Let's get on with our research and so on. Let's keep a low profile". What do you think about that?

(*Dr Ringrose*) I think that was correct at that time. I think all of us now across the pharmaceutical industry together with AMRIC (the Animals in Medicines Research Information Centre), the ABPI and the RDS, the Research Defence Society, have been playing leading role in this, and each of the companies represented here have people that would go out actively now to speak in schools and in universities. The days of "keeping our heads below the parapet" are gone and we feel that now we need to speak out and to be counted. One is seeing that also within the BMA, that doctors are more willing to speak out on this subject.

Chairman

240. Yes, and of course there has been a recent initiative from all the research charities too which I think has been extremely helpful. COPUS is trying to help in this regard; there was a survey I think done by the Research Defence Society where they posed a questionnaire in a group of schools and found that 96 per cent of the children were opposed to animal research; then they went and talked to them and converted them to about 75 per cent in favour, just by giving the facts; it is, as you say, very largely a matter of education.

(*Professor Dawson*) And it is clear that the resolution is not going to be instantaneous. It has got to be a long-term project maintained at school level. It has to happen at schools first.

Lord Porter of Luddenham

241. But you would not go so far in telling the public or enlightening the public in this way as telling them precisely what you are doing and where, would you?

(*Professor Dawson*) I think most of us prefer that the regulation of specific experiments occurs under the Act, but I think equally all of us talk about the discovery of medicines, the process, and the fact that we use animals in that discovery process openly and on many different stages and it is our business and we have to defend it.

242. But it is more difficult than something like Sellafield, for example, where they can open to the public, because you cannot show the public these animal experiments?

[Lord Porter of Luddenham *contd.*]

(*Dr Elves*) We certainly could not let the public into our animal houses, for the very good reason that they could become a health risk to the animals.

Chairman

243. Of course, and I cannot forego the wry comment that the standards required under the law for animal operating theatres are much higher than those for human operating theatres.

(*Dr Elves*) My Lord Chairman, the requirements for the investigator are much higher than any medical practitioner who does not need a licence for every procedure he does.

Lord Nelson of Stafford

244. My Lord Chairman, before you wind up, I wonder if I could just explore a little bit further with our guests this morning the situation in Europe and we have heard quite a bit about America and Japan. You mentioned that Europe is moving forward and it is becoming more and more competitive with British work in this field. I wonder if you could just tell us why that is happening. Is that happening because the governments are more responsive to this, or because the universities are more responsive to this, or because the industries are more responsive to this? Could you give us an overview of your feeling about what is happening in Europe?

(*Professor Dawson*) I think some countries like Spain (and we have a chemistry facility in Spain)—they have set up a formal government policy to look for inward investment in research in Spain, and there are benefits to companies who do work in that country, which are clearly defined. That is a system which is most helpful for companies to understand the shape of the playing field. Spain has been particularly good in identifying both the shape and the game which is to be played on it.

245. That is government-led?

(*Professor Dawson*) That is government-led.

Chairman

246. Can you specify the benefits, if not today then later in writing because that would be interesting?

(*Professor Dawson*) Surely. My understanding is that for a given percentage of investment of profits back in research in the country, they will have their regulatory agencies move one or perhaps two compounds more rapidly through the system than would otherwise happen. You actually gain by the speed of time to the marketplace.

(*Dr Elves*) The Spanish government will actually positively encourage academic collaborations with industry as part of their overall plan. That has done a lot to improve science in Spanish universities.

247. Any other examples like this in Europe would be extremely helpful to us.

(*Professor Dawson*) I think the other country which formally has done that—I am sure you have seen Canada quoted as an example of how disastrous this is when you have a generic business. They have now mandated to have a percentage of profits returned to research in that country in an attempt to re-establish the research base. That does two things: it shows the problems if you do generic medicine only, but also the positive benefits of requiring percentage investment. I think the PPRS actually gives us a more flexible system and is akin to the Spanish system; no other European country, to my knowledge, has such a system.

248. The regulatory machinery over product reduction in this country, through the Committee on Safety of Medicines, has been quoted as being significantly better than that which exists in other countries; much better and quicker, for instance, than the Food and Drugs Administration in the United States. Would you agree with that interpretation?

(*Professor Dawson*) In general, yes.

(*Dr Elves*) I cannot answer from experience.

(*Professor Dawson*) I believe that the siting of the EMEA here is an indication that there is general European—

249. The European Medicines Evaluation Agency?

(*Professor Dawson*) Yes.

250. It would be useful to have a note on the issues relating to the attitude of other governments, not just in Europe but Canada too.

(*Professor Dawson*) I am sure we can do that.

Chairman] We are very grateful to you for coming along. Thank you very much.

WEDNESDAY 30 MARCH 1994

Present:

Dean of Beswick, L.
Nathan, L.
Nelson of Stafford, L.
Perry of Southwark, B.
Perry of Walton, L.
Walton of Detchant, L. (Chairman)

Examination of witnesses

PROFESSOR RICHARD WESTON, Pro-Vice-Chancellor for Research, and PROFESSOR HARRY THOMASON, Pro-Vice-Chancellor for External Relations, Loughborough University; and MR PETER RAYMOND, Managing Director, UMIST Ventures Ltd, were called in and examined.

Chairman

251. Thank you for coming. Perhaps I should ask you first whether you wish, any of you, to make an introductory statement about the position of your respective institutions?

(*Professor Weston*) My Lord Chairman, from the Loughborough side—we are sorry to take some of the UMIST time—we would like to do a short presentation, perhaps about five minutes.

252. Please do.

(*Professor Weston*) I wish to make a few points in a structured way. At the moment then I am talking specifically about Loughborough, and I want to take just a few seconds to say a little about our background. We are a relatively new university. We have had our charter for about 27 years. We have 'relevance' as a main feature of our research ethos. This does not of course mean applied research; rather it includes basic, strategic or applied that it is relevant with industry or whoever in commerce needs it. We believe we achieved our goal mainly through close partnerships, this mostly with industry. The first point that I should like to make, my Lord Chairman, is that many of our partnerships have been in the United Kingdom. They are our prime partners. However, we see that overseas partnerships are vital to us. It has been important for us to expand our science base. We have more or less doubled our science base in the last five years by many measures. In relation to overseas investment there are three issues I wish to emphasise. Rather than attempt to address this raft of questions we thought we might relate our experience concerning these three points; which are: the nature of overseas investment; the reciprocal benefits as we have seen them for the United Kingdom and overseas agencies; and the reasons for investment. The first of those issues is this, my Lord Chairman [Slide 1]. The United Kingdom undoubtedly has high quality research investment, but the emphasis here is on research, so that we have a world class science base. Loughborough contributes to this in our areas of excellence. However, in many of our subject areas (and we are essentially a technological university) the UK has weak vendors, when compared with their overseas competitors. This is not to say we have weak manufacturers but do have weak vendors of systems and products. This makes us very vulnerable to exploitation from overseas. Another added factor in this, of course, is growing reluctance to put funding into R&D, even though the creation of a new product will require at least an equal investment in development, as it does reasearch. This leaves the United Kingdom open to direct exploitation and there are many examples that we could quote to you today where an overseas agency has come in with R&D funding to produce products perhaps from United Kingdom generated knowledge. Can I emphasise, my Lord Chairman, that in certain industrial sectors we have weak vendors. We do not control the care of multinationals who deliver computer technology. This is true also of systems and products for manufacturing. This is a major problem for the United Kingdom, and we now rely very heavily on overseas agencies for the supply of many hi-tech products. This phenomenon significantly effect investment flows. If we look at the net flows of investment and knowledge related to research activity at Loughborough [Slide 2] there is a sharp distinction between trading with other technically developed nations and trading with technically developing nations. If we look at other developed nations then our experience is one of deficit flows, fairly small flows. Our experience indicates there is more knowledge going out than coming back in. However, we believe that it is essential to have an exchange of knowledge, more goes out than comes in. We also believe that there is a deficit flow of investment and much of this is down to the ways in which we operate within EC programmes but also because of our weak vendor base not taking up new knowledge to create products of systems—perhaps we can investigate that later through questions. Whereas if we look at the technically developed nations there is a much more balanced trading position. Certainly there is a net outflow of knowledge but a large inflow of investment to compensate. Just to emphasise that point, my Lord Chairman [Slide 3], if we look at the nature of overseas investment in research at Loughborough, this include funding of basic research through a spectrum to, at the other extreme consultancy. In total then covering basic, strategic, applied and consultancy. Much of our activity with developing nations has centred on a consultancy, whereas with the technically developed nations the exchange is mainly around strategic and applied research. Here outside agencies have seen that we have something that is world class and they wish to invest in it, often with a view to creating products. They will then provide finance. Often from the academic's point of view this is legitimate. As academics we want to see our ideas used. For us very often we are not so very

[Chairman *contd.*]

worried if funding is from overseas or whatever. Perhaps that is a short-term view, but it does help us as academics get on with our research and come up with the next ideas. Clearly these observations reflect investment at Loughborough and I cannot talk knowledgably about the world scene. Indeed we recognise we are but a small part of the world scene, the size of our activity here is round about £2.5 million per annum with consultancy being around one tenth of that that total. I have copies of these slides if the Committee would like them, my Lord Chairman.

253. Yes, that would be very helpful, thank you.

(*Professor Weston*) The final point, and this really will be quick, my Lord Chairman, is to say that overseas PhD researchers are vitally important to us. They constitute nearly half of the UK science base and are important to us in different ways. They much strengthen our base and we have high quality people gaining there education with us. Also they generate very significant funding for HEIs. In addition to the £4 million per annum invested at Loughborough University, there will be at least £4 million going into Loughborough's local community, there typically being a 50 per cent gearing effect between the university and the community. Subsequently students returning home set up UK clones and constitute contacts which are also of vital importance to the United Kingdom. Most of the overseas students who come to us will have great influence in the future. They will go away and perhaps be politicians or whatever in their own country. This leading to future sales of United Kingdom equipment, etc. I will finish there, my Lord Chairman.

254. Thank you very much. I hope that some will become not only politicians but also scientists! Before we ask UMIST to speak perhaps I could ask some questions. How does that overseas investment for which you have given us figures compare with the investment that you get in your science base from United Kingdom industry?

(*Professor Weston*) It is a relatively small fraction, my Lord Chairman. It must be about 15 per cent of the total.

255. From overseas?

(*Professor Weston*) Yes, I believe overseas income is around 15 per cent of our external income (i.e. excluding our HEFC or core funding). Hence around 85 per cent of our external funding is from the home market.

256. I am not sure whether I have made myself clear. You have funding from the Higher Education Funding Council and you have this external funding, which covers somewhere between 10 and 15 per cent of the cost of your science base, money which is coming from outside sources, EC and other countries abroad. How much money comes into your university from United Kingdom commercial sources?

(*Professor Thomason*) You mean in commercial contracts for research, my Lord Chairman?

257. Yes?

(*Professor Thomason*) It is about £2.3 million a year, £2.5 million a year, from UK industry of a further £2.4 million from the EEC for industry related research.

258. So it is about the same?

(*Professor Thomason*) But it is going up—what is it, £4.5 to £6 million? It depends on which way you look at it.

(*Professor Weston*) Unfortunately we are not necessarily comparing like with like, my Lord Chairman.

(*Professor Thomason*) This is why we are having a problem because it is a much different thing. We get investment from overseas in certain forms, primarily in student fees, people coming for particular purposes to do PhDs with us and to undertake courses that we specialise in.

259. You said that there was £4.3 million income on overseas student fees, but £2.4 million I think—

(*Professor Thomason*)—is primarily EC, 85 per cent.

260. So you do not get much from Japan, the United States and other countries?

(*Professor Thomason*) No, but there is a trend starting where they are talking to us of wanting to do more.

Lord Nelson of Stafford

261. Is that undergraduates sponsored by the country concerned or is it postgraduates coming for specific work?

(*Professor Thomason*) It is a mixture depending on the countries. In some countries it is primarily undergraduates who are selected by their government because of contact between ourselves and their government—and Singapore is an example—or is it an overseas country like Malaysia which is trying to raise the standard of its university staff, so we do a lot of staff training, master's courses and PhDs, we are helping to establish some of the new generation of university staff, they are different kinds of people. Approximately 50 per cent of our postgraduate students, as Richard Weston has said, are from overseas. Quite a large number of them are actually staff from overseas universities.

Lord Perry of Walton

262. Do you have any idea of what proportion of the £4 million in fees is British money in scholarships?

(*Professor Thomason*) May I just show you where they come from, my Lord Chairman, so that you might be able to see. *(Slides)* Singapore is 212 this last year of which there are none from sources funded from this country; they are all paid for by their country. Then Malaysia, quite a large proportion are paid for by themselves, and there may be a little aid in there. Hong Kong, again paid privately, Thailand, again privately. The African ones will be primarily aid students, a lot coming on ODA contracts, that is, contract money. They are coming in on special courses that we run for them, particularly for example in waste and water engineering.

Chairman

263. And Chevening research scholarships, you do not have any of those as far as you know?

(*Professor Thomason*) I do not think that we have, my Lord Chairman.

(*Professor Weston*) No, we have not.

264. It has been said to us by a number of witnesses that some of the overseas companies, particularly from USA and Japan, are prepared to invest in UK science on a long-term basis in the hope of achieving returns that may not come for ten or 15 years where British companies tend to take a much more short-term view.

(*Professor Thomason*) We have one example from Japan which has been going on for about four years, and this is in fuel cell technology, which is obviously a burgeoning thing. We have two very competent young men who are researching in this area, they could get no money from the UK science base four years ago and they were initially funded by the Japanese. The Japanese have made a long-term investment in that group hoping that it will be a successful commercial venture in the future. They are now getting funding from the science base here because it is now a successful research group, but the initial funders were Japanese.

Lord Perry of Walton

265. Is it possible that you could let the Committee have a note of what proportion of the money is an inflow to this country?

(*Professor Thomason*) Yes, we could, my Lord Chairman, that is no problem.

Chairman

266. That would be helpful, thank you.

(*Mr Raymond*) My Lord Chairman, may I perhaps add one point in addition on the Japanese dimension. The two longest running continuously funded research groups that we have at UMIST were Japanese companies, one with Kobi Steel, one with Nippon Paint, and respectively they are ten and 11 years old with continuous funding on strategic research where there is a continuous exchange both of research students and staff between UMIST and the sponsoring companies so those are good illustrations of the kind of strategic commitment that you are indicating does exist. We see that only with Japan; we have not even seen it with American sponsors. Continuing usually with a good American sponsor we have had periods of four to six years, but certainly not the decade of continuous support for long-term research that we have seen with Kobi and Nippon in particular, and there are other Japanese companies with whom we have been working for four to six years on a continuing basis which seem likely to continue in the same way as those that exist with Nippon and Kobi Steel.

267. Thank you. The evidence that we have had about long-term investment from the USA in the United Kingdom is almost wholly in the pharmaceutical industry, which of course you are not particularly involved in.

(*Mr Raymond*) Indeed, absolutely, my Lord Chairman.

268. Would you like now to make your opening comments, Mr Raymond?

(*Mr Raymond*) I was not going to, my Lord Chairman, but if I could that would be very helpful just to set the scene and to complement some of the points that have already been made. *(Slides)* These are small, my Lord Chairman, and I apologise if you cannot see them clearly. All I am going to do is to set a brief scene and just show you that we are wholly technology and science driven. We are engineering and pure science. We have a very large school of management, the Manchester School of Management, as you know, which is about to become the Federal School of Management and we have a specialist department in computational linguistics, which is where a lot of Japanese continuous funding comes from.

269. Is that what used to be the Manchester Business School?

(*Mr Raymond*) No, Manchester Business School is separate. If we just look at what that means in terms of income from research grants and contracts on the left are the funding sources and I concentrate only on the overseas ones. It is very significant that we have moved very quickly from virtually no funding from the European Commission to its being now one of our six primary funding sources and this year it represents about 25 per cent of our research funding across a huge array of initiatives, and I will return to that in a few minutes because it is one of the trends that we see very clearly from the sort of questions that you have asked us to address at the beginning.

270. Forgive me for interrupting, but one of the things that we have tried to discover is the extent to which money that comes back to us from the European Commission is money which this country contributed in the first place; that is not a question that you can answer?

(*Mr Raymond*) No, quite, my Lord Chairman.

271. We will have to try to find that out from other sources.

(*Mr Raymond*) Absolutely, my Lord Chairman. If we look at UMIST international dimension as a whole, students very similar to Loughborough, we have and always traditionally have had a very broad international representation of countries in UMIST. On an average year we have students from between 85 and 110 countries. For both cultural and the provision of resources reasons we have 23 per cent as a limit on the number of students that we can take from overseas. The reason that that is an important figure is that we could easily fill all our engineering departments with foreign students. Whereas the demand from the United Kingdom is falling for engineering the demand from overseas is increasing. Without any doubt at all all our engineering departments could fill themselves and generate the appropriately larger amount of income from student fees from overseas so that this is a very important issue.

Lord Nelson of Stafford

272. That is undergraduates, is it?

(*Mr Raymond*) This is undergraduates essentially. We can only accommodate, my Lord Chairman, about 600 postgraduates seriously. The number has been fairly static at around 500 to 600 postgraduate

[Lord Nelson of Stafford *contd.*]

students because of the supervision problems from overseas.

Chairman

273. Is the position comparable in the physical sciences?

(*Mr Raymond*) It is not, my Lord Chairman.

274. It is not?

(*Mr Raymond*) No.

275. So you are getting more British students, UK-based students, in the physical sciences?

(*Mr Raymond*) We are unfortunately getting more UK-based students for the management sciences.

276. But what about traditional physics and chemistry?

(*Mr Raymond*) Struggling also, my Lord Chairman, hanging in but struggling.

Lord Dean of Beswick

277. You said, I think, that there is a falling application for places in engineering from home base?

(*Mr Raymond*) Correct.

278. Does that have a relationship to the reduction of our manufacturing base in general?

(*Mr Raymond*) I do not think that there is any doubt, my Lord Chairman, that there is a direct correlation, absolutely, and we see that in our relationships with industry as well. On a continuing basis it is very hard to sustain serious long-term strategic relationships with the United Kingdom manufacturing base, and I think that Loughborough have indicated exactly the same thing?

(*Professor Weston*) Yes.

(*Mr Raymond*) Foreign students then are very important. Academics are also important. This was not referred to, I think, in Loughborough's presentation, but we have representatives among our 420 academic staff of 67 different countries so again foreign academics are a fundamental and key ingredient in our ability to deliver education.

279. My Lord Chairman, may I go back to the question of engineering students from over here. Can you give any indication in numbers of the percentage reduction over the last ten years?

(*Mr Raymond*) What I can do, my Lord Chairman—and I do not have it with me—is to give you the exact balance of applications over that ten years if that would help the enquiry.

Chairman

280. Yes, thank you, that would be very helpful.

(*Mr Raymond*) We can return that to you, my Lord Chairman.

281. Not just in engineering and technology but in the physical sciences.

(*Mr Raymond*) Absolutely, my Lord Chairman, yes. We could easily supply those statistics for you.

(*Professor Thomason*) And we could do the same, my Lord Chairman.

282. Thank you, that would be very helpful.

(*Mr Raymond*) Quickly let me say that we have been successful in exports. We won the Queen's Award for Export Achievement last year. European grants are expanding at a very significant rate across all the initiatives, which I will show you in a second, my Lord Chairman. The Japanese dimension is important and both the European activity and the Japanese activity are now supported by a dedicated resource. We have a Japan office with a Japanese speaking lady managing it and we have a European office with a French speaking lady managing it and three of us regularly Luxembourg and Brussels on a monthly basis, my Lord Chairman, and that has borne fruit in terms of supportive income. As regards our future plans for international activity just to emphasise the promotional needs of universities in the United Kingdom today, there is a China technology link which we are just establishing, a St Petersburg office where we are working already with three universities in St Petersburg and a Berlin collaboration—because it is our conviction that over the next five to ten years the centre of Europe will be Berlin and unless we are represented there we will not be as successful as we should be in terms of generating sponsored research—and a USA initiative which is focused on the use of one of our expatriate graduates who are helping us. On the other side—this is the question that you asked about intellectual property, my Lord Chairman—the ownership of intellectual property is increasingly difficult by universities because both United Kingdom and international industry now realise the true value of intellectual property so whilst UMIST Ventures has been set up to exploit intellectual property through licensing and venturing and we have set up seven limited companies in the last four and a half years, that is as much a defence mechanism as anything else because it is very hard now to negotiate serious income-generating relationships with the serious sponsors of research. They want access to our brains, they want access to our technology, a lot of which is funded from the British taxpayer, and they want to take it away, add value to it and sell products at a higher value to our disadvantage. There is no doubt about that, my Lord Chairman: it is a clear trend and we can give you plenty of evidence to support that, as I think Loughborough also indicated. Going on very quickly, the order income is continuously steady. This year for some reason we are having an absolutely extraordinary year. Last year we generated £14 million of new research and this year we are already at £14.6 million after eight months of the year so we are anticipating generating something like £18 million worth of new research contracts in the current financial years.

283. From overseas?

(*Mr Raymond*) No, my Lord Chairman, the overseas dimension, if you take out the research councils, represents about 40 per cent. If you include the research councils, it drops back to about 25 per cent.

284. Then may I follow that up and put to you the same question that I put to Loughborough. How does your investment in your research in UMIST

[Chairman *contd.*]

from overseas compare in cash terms with investment coming from United Kingdom commercial sources?

(*Mr Raymond*) At the moment, my Lord Chairman, if you include the EC it substantially outweighs it. If you extract the EC the support that we get from UK industry is still higher than from overseas industry.

285. Are you having difficulty in, let us say, developing collaboration with local industry for sandwich courses, for instance, in engineering and technology, and what about CASE studentships?

(*Mr Raymond*) My Lord Chairman, CASE studentships are very successful because they are cheap. Even ICI, who are a very difficult company to work with on the research front because they dilute their effort very broadly all over the campuses of the United Kingdom do support very actively the CASE award because it is good value. If you take the new initiatives we found them particularly successful in things like the postgraduate training programme. We have been very successful in that. We are running 20 different programmes with the aid technology and we are extending that to British Aerospace and a number of other partners so it is a mixture, a mixed bag. I think that where it really has merit is at the appropriate interface where the bureaucracy is low and the rewards are high, and the postgraduate training programme is such an example and the teaching company scheme is another good example. In those areas we can work with British industry well, but across the board, no, my Lord Chairman.

Lord Dean of Beswick

286. Has the reduction in the numbers applying for these courses that you mentioned bottomed out or are they still falling?

(*Mr Raymond*) My Lord Chairman, they are still falling, yes, and there is an extension of that as well which is equally disturbing. That is that if you look at the results, particularly in the schools of engineering, and if you pick the two best that we have, that is, electrical engineering and chemical engineering, you will find that at the top 12 firsts or 13 firsts you will see 10 or 11 foreign students rather than British students so it is not just numbers; it is also quality. That is very disturbing from our point of view.

Lord Perry of Walton] My Lord Chairman, may I make the same request here as I did to Loughborough. Can you let the Committee have a note of what proportion of the postgraduate students are funded by money that comes from British sources?

Chairman

287. You stressed the importance also of academics from overseas working in your institution. How do they come? Is it on sabbaticals, on scholarships or what other kind of funding brings them to work in UMIST, and for what sort of period?

(*Mr Raymond*) Surprisingly, my Lord Chairman, for very long periods. They tend to come to England because of our style of living and our culture and historically that has been a real attraction to many academics. It is very interesting because recently we ran a perception of UMIST Ventures that academics have and we also reciprocated by taking a view of where academics viewed now their United Kingdom lifestyle, and the majority of those who made a career decision to come to the United Kingdom in the sixties and seventies when we had our major growth because money was freely available at that time, and I suspect that probably it was not that dissimilar for Loughborough, a lot of foreign lecturers, senior lecturers and professors came to the United Kingdom to take advantage of that. I think that if you asked many of those today whether they would do it in today's circumstances, my Lord Chairman, they would say no because of the circumstances now where they are being asked to do such a broad array of activities that they cannot focus on what were culturally very attractive conditions when they first came but no longer exist today in the academic environment.

Lord Nelson of Stafford

288. What exactly do you mean by cultural attractions in the academic world?

(*Mr Raymond*) When they first came, between the late sixties and the late seventies, you could do teaching and research and you had time to think. I am not an academic by the way, I hasten to add, my Lord Chairman. I am a businessman who is trying to help technology transfer and I have been in academe for only four and a half years so I have no academic axe to grind at all. There is absolutely no doubt whatever, however, that the workload and the variety of work and the pressure that exists within academe makes life a very unhappy and less than satisfying activity for those academics who came in either to teach or to do research because they are now expected to generate income, to market their wares, to do administration, to do research, to do teaching, and it is absolutely impossible and we are not benefiting as a consequence of that. That is the cultural issue.

Baroness Perry of Southwark

289. May I ask all our witnesses this, my Lord Chairman. They have mentioned in different ways the competitive nature of bringing in overseas students and investment and the promotion activities that are necessary. Can you tell us something about that? Who do you see as our major competitors and how do you go about it? Both universities have been very successful in bringing in overseas research. How have you done it?

(*Professor Thomason*) My Lord Chairman, we have a very special policy on this. We do not have courses for overseas students; we just have courses for students and we attract by direct government contact or by contact through universities or other contacts, e.g. people whom we think would be successful on our courses so we always have about 9 or 10 per cent of our students who are overseas students, but we do not bring them in unless we think they can be successful. What I said at the beginning, my Lord Chairman, was that we have a number of schemes which are directly related to overseas students. I wonder whether I may just show one other slide to illustrate how many students come to do engineering because of the concern of the noble Lord

[Baroness Perry of Southwark *contd.*]

Dean of Beswick about engineering. I will explain how we do it because I know that you are going to Malaysia and Singapore next week where I was last week. *(Slide)* I am sure we are very similar to UMIST: we are targeted by overseas countries that are trying to develop their industrial base. These are developing nations. Malaysia wants to be developed by 2020, and the noble Baroness Lady Perry will certainly hear a lot of this next week. In Singapore they are very developed and they are up with us if they have not already passed us. They have a better group of science, maths and physics teachers who teach in the schools than we have in UK, their 'A's' are Cambridge overseas 'A' levels and they are one grade better than ours. They have a very high number of students who want to go onto do maths, physics and chemistry and who want to go on to do engineering. They cannot all get into the two universities. My university has a strong involvement with them at the technological university and assisted them in setting it up. You can see how they are targeted. *These* you see are primarily coming to do engineering, e.g. electrical engineering, and a very special group (Sports Science).

Lord Nelson of Stafford

290. May we be told which are undergraduates and which are postgraduates?

(*Professor Thomason*) The majority of them from Singapore will be undergraduates, but there are a number of postgraduates. In Malaysia it is primarily half and half where the post-graduates tend to be staff from the universities upgrading their qualifications.

Chairman

291. For the transcript you might just read those out.

(*Professor Thomason*) I have copies for your Lordships, my Lord Chairman. I will give you a copy of all these things. You can see from the overhead where these tend to be very special. Of the majority of people coming only eight others come from other subjects apart from the 37 who come to the Sport Science department and the rest are coming into engineering. They identified Loughborough and UMIST as places of excellence where they want our expertise.

292. You of course are a technological university.

(*Professor Thomason*) Yes, my Lord Chairman.

293. So many other universities would attract people in other fields. Figures from the British Council indicate that if you take the whole number of postgraduate students coming to the United Kingdom those in science and technology represent a diminishing proportion, which is somewhat depressing.

(*Professor Thomason*) Yes, indeed.

294. And I presume that your two institutions are in competition?

(*Professor Thomason*) Yes.

295. Hence there is no doubt that you are both competing for the same cadre of overseas students and for overseas investment. You have given some indication about how you seek that investment. Are you aware of any comparable investment by United Kingdom interests and companies and academic science and technology overseas?

(*Mr Raymond*) My Lord Chairman, I know that many of the large corporations for obvious reasons have subsidiaries all over the world tap the academic institutions in other parts of the world, but it is one of the joys still of being in the United Kingdom and being a proud UK citizen—and not many people do express such pride nowadays—that being an academe you can express such pride because still (and it is going to change but it is still so at this moment in time) the United Kingdom is recognised world wide as being a generator of high quality research results and the technology that comes from that. In that sense as a nation we attract a tremendous amount of interest from both the developing countries, as Loughborough has indicated, and from the advanced countries. That is very reassuring. You are right, my Lord Chairman, it is an increasingly competitive market that we are in, and it is a market. Many British universities have probably been slow to recognise that because there has been a lot of support for expanding student numbers in this country well supported by the Government, but the reality is that in technology and technology transfer from which the second tranche of money will start to flow through venturing, licensing, joint ventures, campus companies which are sold off to foreign investors that is going to happen in the not too distant future and unless universities in the United Kingdom are geared to taking advantage of the science and technology that they generate from the research base then sadly I think that because of the fact that we are not creating sufficient wealth in our own country those that are not successful will in fact start to decline in terms of the quality of research that they can turn out. In respect of marketing we have a director of overseas students. He works with the Northern Consortium. The Northern Consortium over the last eight years has generated more than £25 million worth of income from overseas students, and that is just in the north west, so it is a very powerful and active group. As has been indicated by Loughborough, they spend a lot of time in developing countries like Malaysia and Singapore and Hong Kong on so on. Then on the more commercially driven side, as I indicated on the slides, we are very active both by visits and by attracting visitors in the areas of Europe under the auspices of the European Commission and of Japan. We found it very difficult to attract continuing sponsorship in America, particularly at the moment where it is very competitive since peace broke out.

Baroness Perry of Southwark

296. My Lord Chairman, I do not think that I have quite had the answer to my question. We know how successful they are. I would like to know what is the key to success.

(*Professor Weston*) My Lord Chairman, perhaps I may try to answer the question of the noble Baroness. Certainly we have experience of overseas multinationals investing in Loughborough research, but not on the long-term basis that the Lord Chairman talked about from Japan. The overseas

[Baroness Perry of Southwark *contd.*]

multinationals who are investing with us seek the best available. In research they are saying, "Where is the world's best—wherever it is, we will invest in it". In the main however neither are UK- based companies investing long term. Like overseas agencies they are going for niche research sources—wherever it is they will go and buy it".

297. My question was, was is the secret of your success?

(*Professor Thomason*) In attracting students?

298. What do you do? We have heard from UMIST they have an internal device and they work with the Northern Consortium. Do you have a similar answer?

(*Professor Thomason*) We work by ourselves, very much so.

299. Do you have a full-time officer?

(*Professor Thomason*) I am one of the people with responsibility for that, but I have a group of people who tend to be the course tutors; they are the people who understand the courses and who work with us through our committee which I chair in the university to make sure that we present ourselves in the right way to overseas organisations. I tend to take the lead with a number of the main British manufacturing companies like British Aerospace, Rolls-Royce, British Gas, where we are involved in assisting them in putting education and training packages into contracts that they are trying to secure overseas. As one example of that I work very closely with Aerospace in a number of their offset programmes e.g. in Malaysia and, as it is hoped shortly, in Indonesia where we are putting education and training packages into universities and helping to develop the universities. Like most universities in this country we have a number of our ex-students who are very important people back in their own countries and we use that network. We are approached in the way Richard Weston said, and I am sure that UMIST would say the same, because of our expertise in certain areas. They approach us for information and advice. They are trying to reach the same level as ourselves. Malaysia is a very good example of this. They have been told this last week that there will be another six universities. They do not have enough people to fill all the staff positions in the present universities so they are looking to ways in which they can increase the number of academic staff of the right calibre. We are getting involved in that and our companies in this country are investing in that in order to orders overseas. We have a very special role, and a very confidential way in which we approach these people. We have longstanding arrangements with Singapore. I have been an adviser to their ministry of education for the last 14 years. We have been advising the ministry of education in Malaysia now for about four years and we do it that way.

300. Do you find that the UK science base is sufficiently strong to continue to command respect? You do not have any queries now raised about whether we are falling behind America?

(*Professor Thomason*) We are under very direct strong competition from North America and Australia because of lower fees, also Japan, France and Germany. They are making very big overtures and they have massive marketing campaigns around all the developing countries. What we do find, my Lord Chairman, is that a lot of the people in the old Commonwealth countries or the existing Commonwealth countries are still keen to come to the United Kingdom for the way in which we teach our science. Many of their educational systems are allied to our own educational systems and therefore this is the affinity with us. We have one very big advantage: we speak English and so do they, and many of the courses are in English.

Chairman

301. It has been said to us by a number of witnesses that the present core infrastructure funding for the science base in this country from public funds has meant that many departments are not as well found and not as well provided with high quality equipment as was the case in the past. Has this caused any detriment to recruitment? Secondly, we do need to know how these overseas academics come to the United Kingdom, for how long, how are they funded, and whether they retain their appointments in the countries from which they come and to which they subsequently return? It is a very important issue that we should like to have evidence about, but you will need to write to us about that later. What then about the issue of the core infrastructure funding?

(*Professor Thomason*) Yes, my Lord Chairman, it has had an effect. As to what they will do now, if we take, let us say, Singapore, which is a very developed country, a student going to do research funded by the Government or by one of the universities will select a high quality research organisation or a research group, and they are looking more to North America and other countries where these groups are better funded and better equipped. One of the reasons that we still keep getting students is because in Loughborough—and I am sure this applies to UMIST as well—we have relevance to industry because we work very closely with industry. In respect of some new initiatives that we have with companies like British Aerospace we actually have access to their research equipment because we are known as a centre of excellence for research work, which is a new development.

Lord Perry of Walton

302. You have told us, both of you, about the facts and figures, and we are hoping to get them in writing from you. Would you like to guess as to what the next five years will do?

(*Professor Thomason*) My Lord Chairman, we are striking up some very strong alliances with industry in this country which we hope will be of benefit to both of us. If we do not do that, my Lord Chairman, I do not think that we will be in the first division five years from now in many areas unless we are funded from outside, and the funding could come from overseas. The South Koreans are now chasing us, wanting to set up science parks and wanting to have help to set up science parks to tap into our research.

Lord Nelson of Stafford

303. My Lord Chairman, I should like to clarify the question of why these various overseas interested parties are coming here or coming to you as individual universities. You touched on a lot of the reasons for that. May we just concentrate solely on what I should call the postgraduate phase, not the teaching phase, the people coming here for a specific purpose. Those seem to get their funding from three different sources from what you have told us: from the European Commission, from other universities and from individual firms. Can you tell us briefly the difference between the three sources of investment and why those three sources want to make an investment here?

(*Professor Thomason*) From Loughborough's point of view, my Lord Chairman, we get about £2.4 million a year out of the EC because British universities seem to be pretty good at applying for this money. The ability to exploit it is always difficult because, as my colleague has said, there are not many people interested in exploiting some of the things that we do and this tends to be taken up by others from overseas. The money coming from EEC is usually consortium money that is coming to groups in the university, other universities in Europe and partner companies, so that is one type of money. From an overseas point of view some of our companies in this country are investing in the university and have made strategic decisions to work closely with the universities. Rolls-Royce do it very confidentially, British Aerospace have set up four universities as their centres of excellence to network out into other universities and they are seeing universities as important partners in developing the next generation of technology. If they do not do this and make strategic decisions we will be behind. We have identified one or two areas, and British Aerospace is an example where we think that we are still in division one so we are working closely with them. Other countries are identifying some of these areas and sending their staff, and the Chinese do this in a very particular way. They identify research groups in British and American universities and they send staff to those universities in order to—

304. Who, the Government or enterprise?

(*Professor Thomason*) The Chinese Government. They send individual staff from the universities, to do PhDs, with good research groups hoping that they can clone off some of this research when they go back.

305. If that is a good thing for them is it not a good thing for us to send our academics to other universities?

(*Professor Thomason*) It could be, my Lord Chairman. It might help with future trading, yes. There could be some interchange and it could help with future trade.

(*Mr Raymond*) My Lord Chairman, the EC of course is promoting that strongly. If you look at the fourth framework programme there are four activities, and activity two is very powerfully trying to promote that kind of exchange of excellence between universities and research centres throughout the Community, so that is a key ingredient. I should just add to what has been said in answer to the five-year programme question as to where we are going in five years and to support what has been said by Loughborough about why people come to the United Kingdom. You will find that virtually every British university in some form or another is trying to establish some kind of centre or centres of excellence, and Loughborough obviously has its strong reputation in engineering and we have a very powerful reputation in chemical engineering and electrical engineering, instrumentation, corrosion—unique departments where overseas companies and overseas universities which want to set up the same kind of activity will come to the United Kingdom at the undergraduate and, as you are rightly indicating, at the postgraduate levels to take back both the managerial and the operational skills. We then follow them and help them to set up, and both in the east European initiatives and things like the Tempus programme we have enabled countries like Poland and Czechoslovakia and Hungary to set up state-of-the-art laboratories with equipment that we cannot afford to buy ourselves, my Lord Chairman. This is an extraordinary thing because we are actually feeding the competition in the long term. If you look at Singapore and Malaysia, and like our friends from Loughborough I was there last September for a couple of weeks, their institutes, that is, their manufacturing institutes and their electronic institutes, are absolutely magnificent. They are funded with absolutely start-of-the-art equipment. They bring in the latest quality of people from all over the world to lead those institutes to enable them to deliver high quality services to industry, not to academics, my Lord Chairman, but to industry. This is certainly something which is going to impact upon our economic capability in competing in the world in the future.

Chairman

306. And virtually none of that equipment, even though some of it is based on British invention, is manufactured in the United Kingdom?

(*Professor Thomason*) That is very true.

Lord Dean of Beswick

307. In some of your answers a few minutes ago you mentioned the question of your relationship with some of the major industries such as British Aerospace. Do any of you have any connections or involvement with the nuclear industry, the energy side, and is that still going ahead and developing or are we losing ground in this area?

(*Mr Raymond*) My Lord Chairman, I do not think that we are losing ground in this area. We have very powerful relationships not just in the United Kingdom but overseas as well and we have a centre of excellent in process integration which works very closely with the nuclear industry world wide. We have a corrosion group which works extensively, and in fact, my Lord Chairman, we have spun off two companies, both of whom work very closely with the nuclear industry world wide as well, so I should say that certainly as far as the UMIST experience is concerned we have kept very closely involved with the nuclear industry and intend so to do in the future.

Lord Nathan

308. I get a rather depressing impact of the evidence that you have so far given us. The question in my mind is whether international investment in UK science, which is the subject of our study, really means that people from overseas are sucking your brains and taking the product abroad. To what extent do you find that those people who come to you are minded to place orders for goods or, indeed, for further research in this country which would not have been the case had they not been here to start with?

(*Professor Thomason*) My Lord Chairman, I think that it is a mixture. I think that they are getting a bargain, that is number one, without doubt they are getting a bargain, and they know it. The way we are seeing things now British companies are very much getting into meaningful partnership with British universities to look at ways in which we can keep hold of our skills and acquire new orders overseas. One of the first ways is to get the attention of people who are going to be the purchasers, and that is through studentships, so they are sponsoring students to come in through their offset programmes in for example the aerospace industry. These people coming in mean that we hope they will stand by us in the future. If you take one of the largest recently privatised industries in Malaysia the top six people of that company are ex-students of ours, and that puts us in a very strong position and, it is hoped, will help us and a number of companies who have worked with Loughborough to secure orders for us.

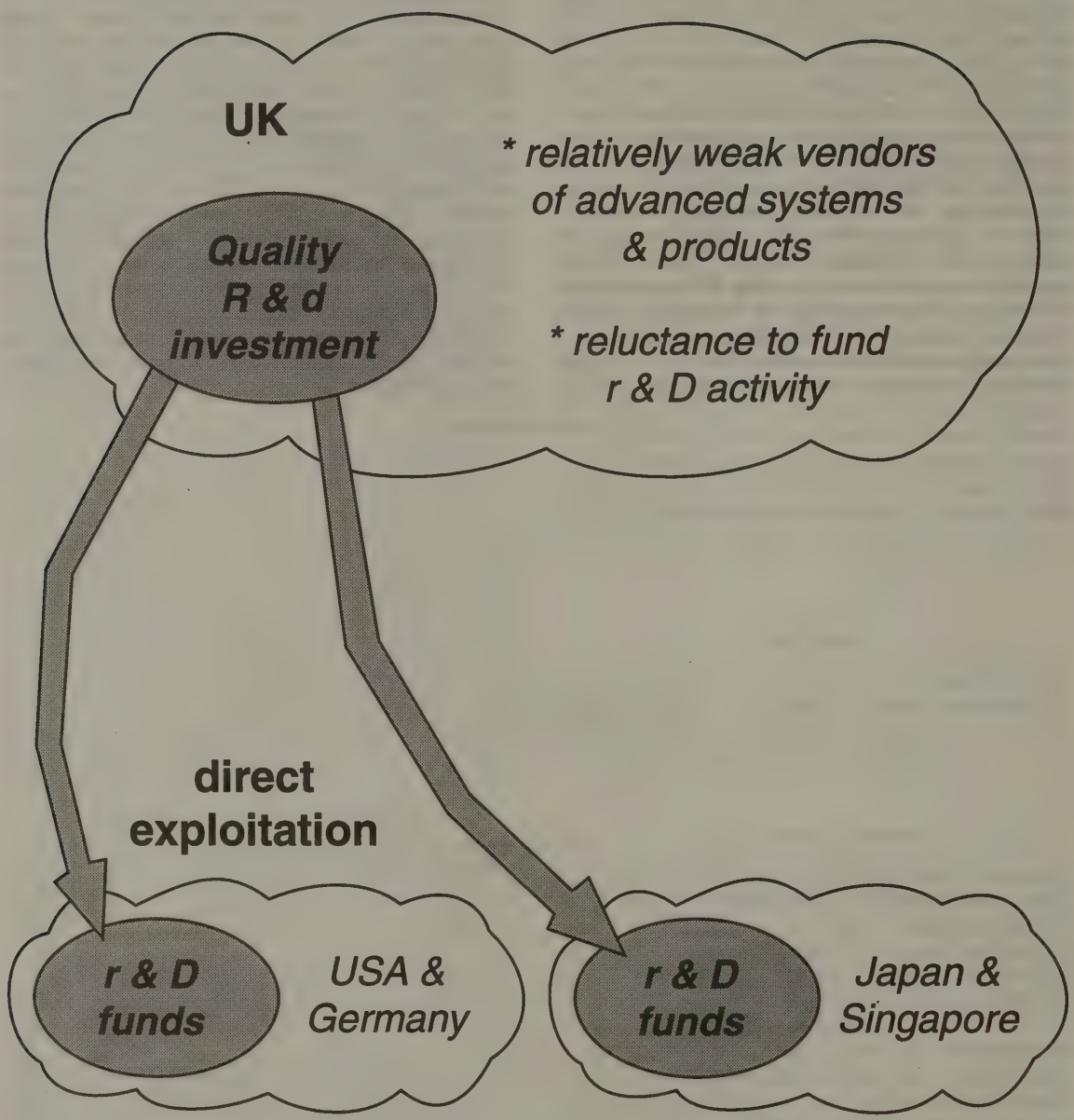
309. But can you identify an instance where this has worked as opposed to a hope?

(*Professor Thomason*) My Lord Chairman, there are some orders coming through which I cannot—well, I have to be very careful. There are a number of contracts that have been secured by the aerospace industry in recent times from people who were trained in the United Kingdom and have a very strong affection for the United Kingdom and their children and their friends' children are being trained in our universities at the present moment.

Chairman] I think that we must ask you to write in about ways in which we could in our report make suggestions that could contribute to the revival of British manufacturing industry through the exploitation of inventions arising out of this kind of approach, and we should be very happy to have your suggestions for our consideration. There is one last point before we move on to our other witnesses this morning. When you send your information about undergraduate and postgraduate students and the funding sources from which they come would you also please let us know in the postgraduate field in particular but also in the undergraduate field what proportion are coming to degree courses and what proportion are coming for diploma non-degree courses? Thank you very much.

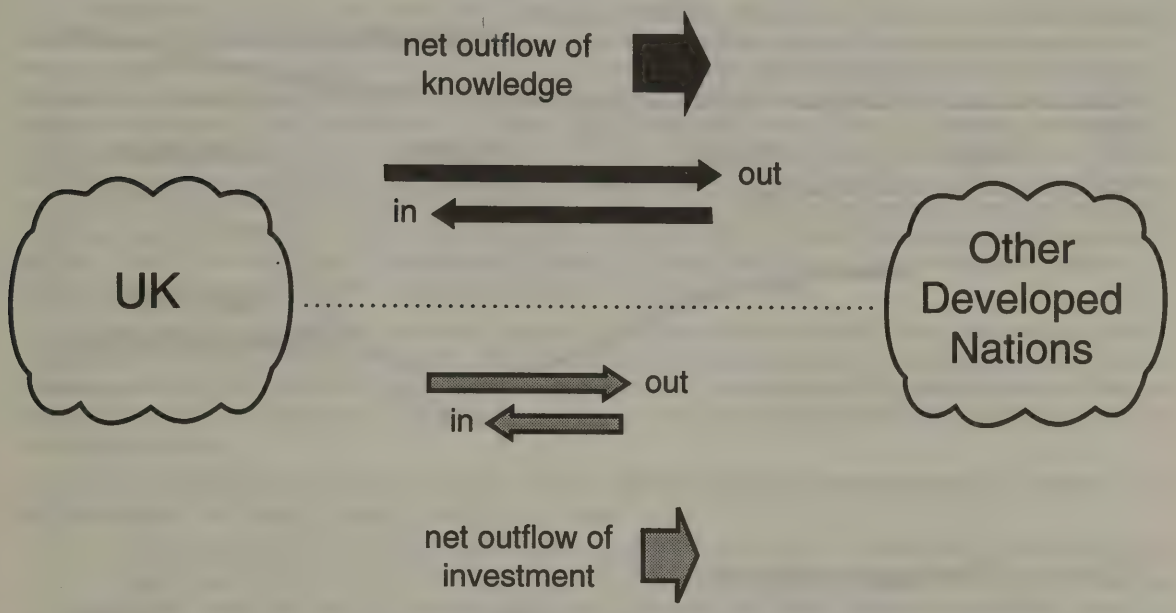
SLIDE 1

A threat – overseas exploitation of UK public funds

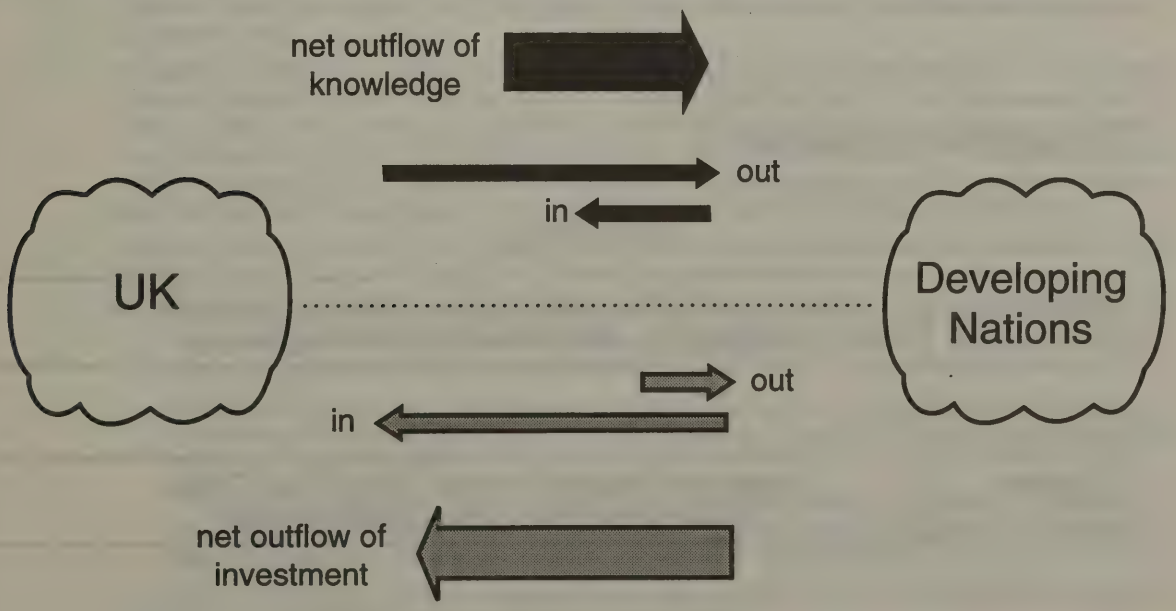


SLIDE 2

Net flows of investment & knowledge



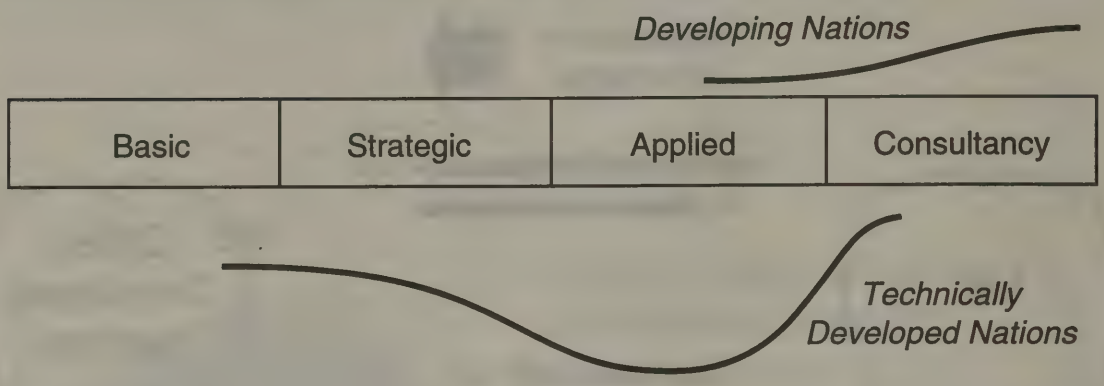
BOTH DEFICIT FLOWS



MORE BALANCED TRADING

SLIDE 3

Nature of Overseas Research Investment at Loughborough



Extent of Overseas Investment

	92/93	88/89
Research Contracts	£2.5 M (85% EC)	£1.6 M
Consultancy	£259 K	£100 K
Training	£4 M	£2 M

Concentration of Investment

Main Areas

Research	*Manufacturing, Computer Science, Water & Environmental Engineering, New Materials & Civil Engineering*

Origin of Investment

Training	*Singapore, Malaysia, Europe, Hong Kong, China, Netherlands, North Africa, South America*

Memorandum by the British Council

1. BRITISH COUNCIL CONTACTS SUPPORTING INWARD INVESTMENT IN UK SCIENCE

1.1 *Have you evidence, whether systematic or anecdotal, of the extent to which contacts initiated by the British Council lead eventually to overseas investment in or sponsorship of British science?*

1.2 The British Council works to initiate, encourage and develop research and other professional contacts and collaborations between the UK and other countries. Such contacts and collaborations are more useful if they are sustainable. The British Council's resources are limited and our roles are to support initial contacts and to help these develop when necessary. To be successful, collaboration has to be mutually beneficial and to secure the means of continuation from national or international sources. There are transfers of resources and benefit in both directions and therefore inevitable examples of investment in British science. This is particularly so for the science and technology (S & T) research the British Council supports in various ways between the UK and other advanced industrialised countries. Our work in the less industrialised and emerging economies is more aligned to developmental objectives, ie those of the Overseas Development Administration (ODA). Even so, in the cases of research collaboration between the UK and the developing countries the British Council supports the British partners to secure a variety of benefits.

1.3 The British Council's science work in Japan over the last 15 years has produced many good examples of Japanese investment in British science. The British Council's contribution in these examples has varied between providing individual exchange of person grants during the contact building stage to that of a more central brokerage role. The role of the small science team based in the Tokyo office of the British Council is crucial to this work.

1.4 Some examples of inward investment to and sponsorship of British science occurring as a result of and with the help of the British Council's work in Japan are:

- Japanese provision of an advanced spectrometer (MARI) built in the UK for the ISIS neutron spallation source at the Rutherford Appleton Laboratory. This formed part of an ongoing collaboration between the Japanese National Laboratory for High Energy Physics (KEK) and the Science and Engineering Research Council (SERC). British Council support was provided during initial exchanges between Professor Alan Leadbetter and Professor Ishikawa and during the negotiations of the eventual agreement.
- As part of an agreement on collaboration in the use of muons for research between the Japanese Institute of Chemical and Physical Research (RIKEN) and the SERC, the Japanese are investing some £7 million in a joint muon production facility at the Rutherford Appleton Laboratory. The British Council have supported the evolution of the collaboration and individual exchanges which go back to 1983.
- A research project into "atom arrangement, design and control for new materials" to run from 1990–95 with a total joint UK and Japanese budget of £10 million. In the UK, research led by Professor Bruce Joyce is being conducted at Imperial College of Science, Technology and Medicine and Cambridge University. Since inception over £1 million has been invested in equipment in the UK. The success of this collaboration is encouraging the Japanese sponsor, the Japanese Research and Development Corporation, to consider further investment in UK/Japan collaboration.
- Other Japanese investments in facilities in the UK have resulted from contacts supported by the British Council:
  - Honda established an advanced wind tunnel and test facility at Imperial College as a spin-off from a British Council supported collaboration between Professor C Caro and Professor Sugawara (a former British Council scholar).
  - The Eisai Laboratory at University College, London and the Hitachi R&D Laboratory at Cambridge followed British Council assisted academic exchanges which helped pave the way to the Japanese investment.
  - The creation of the Sharp R&D Laboratory at Oxford was strongly influenced by Dr Kataoka, Sharp's Research Director, who is a former British Council scholar. Dr Kataoka's decision is likely to have been coloured by the time spent in research in the UK.
- A number of smaller research contracts have been placed with UK academic and research institutions as a result of initial British Council activities:
  - The Japanese New Energy and Industrial Technology Development Organisation (NEDO) has contracted research in silicon based polymers from Dr R G Jones of Kent University. Funding is expected to be of the order of £70,000 per annum for the next eight years. The British Council identified Kent as a prospective bidder in response to a NEDO tender.

— The Japanese Company Matsushita has contracted research services from the Centre for Satellite Engineering Research at Surrey University as a result of a British Council visit to Japan made by Professor B Evans in 1992–93.

1.5 In its operation in Western Europe, the British Council supports research collaboration between British and European researchers, many of which have gone on to secure additional national and international research funding, the latter primarily from the research and technology development programmes of the European Union (EU). This additional funding benefits the UK researchers and their institutions but in a strict sense might only be claimed as inward investment in R&D if the UK exceeds "juste retour" for its own contribution to EU research funds.

1.6 The joint research programmes (JRP) run by the British Council in Europe have enabled a number of the collaborators to secure EU funds. Returns from some of the participants in these programmes have confirmed substantial additional research funding:

— In Spain, the JRP, the so-called Acciones Integradas programme, supported 120 joint British and Spanish research collaborations in 1992–93 at a cost to the British Council of £269,700. Returns from some of the participants have confirmed £1.2 million additional funding for 1992–93 from the EU, with a further eight projects with as yet unconfirmed amounts promised by the EU. In addition, a further £650,000 was received from other sources, eg NATO, ESF and national bodies.

— In Germany, the JRP, the ARC programme, at a British Council cost of £500,000 in 1992–93, should be set against, according to returns from some 30 per cent of the participants, some £4.72 million of additional R&D funding for further research secured in that year (this will have resulted largely from links established earlier). The actual figure may be substantially larger. From its inception in 1989–90 until late 1993, the ARC projects had cost the British Council almost £2 million but led onto additional research funding for collaboration of £16.2 million, predominantly from EU programmes.

  — An example of a successful ARC project is the collaboration between the University of Kent and the Foundation for Biotechnology Research in Braunschweig. The British Council contribution to this project amounted to £4,250 but the project subsequently secured funds from the NATO Science Programme and from the EU programmes (ECU 463,000).

1.7 In addition to the JRPs the British Council supports other programmes in Europe that encourage research collaboration and have led to British researchers securing additional international support. Two examples are:

— Since 1978, the British Council and Italian National Research Council (CNR) have run a programme of research exchanges. These have enabled Italian and British research to collaborate and the CNR to fund agreed programmes of joint research. The CNR's "progetti bilatrali" provided some £310,000 to 83 collaborative research projects shared with British researchers in 1992.

— A British Council organised meeting in 1991 of European scientists in the field of "Crops and the Environment" has led onto a EU funded (300,000 ECU) European network of 46 laboratories co-ordinated by Dr Roger Leigh of Rothamsted Institute and involving eight British research groups.

2. British Council Collaboration Schemes

2.1 *Please give some details of your research collaboration schemes. Are they concentrated on certain scientific sectors?*

2.2 The Joint Research Programmes have been developed over the last 10 years and now exist in a number of European countries and Japan. The purpose of these programmes is to encourage research collaboration in areas of mutual interest and priority is often given to projects likely to attract further funding from other sources in the future. Each programme is run in conjunction with a national body in the partner country which provides matching funds to the British Council contribution and therefore there are small variations. However, there are a number of common features:

— the awards are competitive and evaluated by peer review and/or a specialist and joint steering committee. The excellence of the proposed research is a key criterion.

— awards can be made for a period of one to three years.

— the awards are intended as a contribution to the fares and subsistence of a programme of exchanges agreed between the individual collaboration leaders in each country. Support is not available to cover research costs, bench fees, consumables, etc.

— the administration of the collaborations is provided by the team leaders.

2.3 The programmes vary in size. The largest, the British German Academic Research Collaboration (ARC), draws on an annual British Council contribution of £500,000 with a further £610,000 provided by the German Academic Exchange Service (DAAD) and the Anglo-German Foundation. In 1992–93 875 British researchers visited Germany under the programme, with, it seems, a similar order of return visits by German scientists. The JRPs in other west European countries are more modest (details given in Table I).

2.4 In 1993, a JRP was established by the British Council and the Polish State Committee for Science and Technology (KBN) for collaboration between UK and Polish researchers. In its first year total funding amounted to £80,000 with equal contributions from the British Council and KBN. The funds for 1994 are expected to double. Following a pilot stage in 1992–93 and an agreement between the Royal Society and the Japan Society for the Promotion of Science (JSPS) a JRP scheme was established in 1993–94.

2.5 There are generally no specific subject priorities for the JRPs. Some priority is given for projects likely to attract funding from other sources (for example from the European Union programmes). The Polish JRP has a list of subject areas which are given some preference and reflect the broader priorities of the KBN but this is not exclusive. In addition, project proposals which target areas with potential for participation in EU research programmes will be encouraged.

2.6 In Japan, the British Council has since 1989 run the Collaborative Research Project (CRP) scheme. British Council funds are deployed flexibly with a view to attracting Japanese co-funding in the form of equipment, access to facilities, research cost contribution and matching exchange funds. Currently there are some 48 programmes of on-going collaborative research. The CRPs have been used to support activity agreed through the official UK/Japan S&T Round Table Talks which take place every two years. There is a regular dialogue between the British Council staff in Tokyo and the UK Research Councils which helps to determine priorities for bilateral collaboration. In addition, the British Council programmes are used to support the various inter-agency agreements the Research Councils have with Japan.

2.7 In all countries, one-off exchanges, travel grants and fellowships are also used to encourage research collaboration by supporting exploratory visits. In addition, the British Council arrange bilateral meetings overseas or in the UK to bring together specialists in a particular field. This has proved to be an effective way of encouraging bilateral contact and collaboration in priority fields. These so-called "n + n meetings" have generally been run in conjunction with the UK Research Councils and national research bodies overseas.

2.8 The British Council also administers on behalf of the ODA the higher education links scheme which is intended to promote academic collaboration between higher education and research institutions in the UK and aid recipient countries for three years. The objective is to forge links which will contribute towards the national, social and economic development of the overseas country. Therefore priority is given to subject areas which contribute to the development process. Links may involve technology transfer, joint research, staff and institutional development. The balance of benefit is intended to favour the overseas institution but the UK institution may also benefit through staff development, increased recognition and access to unique research data and environments. Collaboration in scientific areas is a significant part of existing awards (Table II).

3. Overseas Post-Graduate Students

3.1 *Do you have up-to-date statistics on overseas post-graduate students at UK universities?*

3.2 The British Council through its Educational Counselling Service (ECS) helps UK higher and further education institutions to promote their courses to potential students in selected countries. As part of this exercise, ECS compiles statistics for students studying in the UK but these are broken down by subject area only for the top 25 countries sending students. These countries, the total number of students enrolling in the UK and the comparable number of post-graduate science students for the academic years 1992–93 and 1991–92 are given in Table III.

3.3 On this basis the countries with the largest number of science students undergoing post-graduate studies at UK higher education institutions are, in descending order: Greece (1030), China (925), Malaysia (886), Brazil (590), Germany (586), Hong Kong (542), Ireland (489), France (457), Pakistan (455) and Taiwan (358). Figures in parentheses are for 1992–93 academic year. The total number of overseas students from these 25 countries enrolling in post-graduate science subjects in 1992–93 was 9,230. Overall there was an increase in numbers from 1991–92 to 1992–93 but as can be seen from the table there are significant fluctuations in figures for each country from year to year, eg there was a large decrease in students from Greece and a significant growth in students from Taiwan.

3.4 This continuing influx of post-graduate students from overseas represents both a significant income for the universities and a major contribution in manpower to the UK's scientific research endeavour.

3.5 *And can you give further details of the emerging competition?*

3.6 Estimates of the size of the global market for overseas study and of the share of this market held by individual countries can only be made by collating data from a variety of sources. The ECS estimates draw on a range of publicly available figures. For the academic year 1990–91 the market shares of the UK and the main competitors were USA (32 per cent), France (10.7 per cent), Federal Republic of Germany (8 per cent), UK (6.7 per cent), Canada (2.8 per cent), Australia (2.3 per cent) and Japan (1.9 per cent). This places the UK with a reasonable share but behind France and Germany.

3.7 The rate of increase in the numbers of overseas students seeking training in these countries over the 10 years to 1990–91 identifies some emerging competitors for the UK. The rates of increase were USA (31 per

cent), France (23 per cent), Germany (58 per cent), UK (51 per cent), Canada (24 per cent), Australia (230 per cent) and Japan (264 per cent). Japan has a national policy to increase its population of overseas students to 100,000 by the turn of the century. Australia is becoming a more significant competitor by virtue of its English medium education and its targeted marketing approach, particularly in south-east Asia. Australia now attracts approximately the same number of students as the UK from south-east Asia, with just three countries, (Hong Kong, Malaysia and Singapore) providing 50 per cent of Australia's overseas population. Australia's overseas students generally study business subjects if privately funded and science and technology when supported by scholarships. These two sectors account for more than 50 per cent of the overseas student population in Australia.

3.8 The USA is the first choice as a location of students wishing to study overseas, eg 81 per cent of Canadians, 78 per cent of Indians, 70 per cent of Chinese, 63 per cent of Koreans and 52 per cent of Latin Americans. However, the UK remains first choice for some countries, eg 23 per cent of US students, 22 per cent of Malaysians and 22 per cent of students from Hong Kong.

4. Barriers to Inward Investment in Science and Technology Overseas

4.1 *Can you give further details of discrimination by some other countries against inward investment in science?*

4.2 In some countries the protection of intellectual property rights, both patents and copyright, can be different to the systems in operation in Britain and within the European Union. This discourages both industrial and research collaboration as British researchers fear they will not be able to satisfactorily protect the results of their research. In addition, there may be concerns amongst UK researchers about the application of such laws. This appears to be a diminishing problem but remains a significant barrier to collaboration particularly in applied and industrial research. Similarly some commentators have drawn attention to the restrictions applied to inward investment in selected industrial sectors and trading barriers which provide an inhibiting environment to research collaboration.

Table I

Funding of British Council Joint Research Programmes (JRP) in the European Community and Additional R&D Funding Secured by JRP Partners in 1992–93

County	*British Council Funding* (£ million)	*Counterpart Funding* (£ million)	*Known level of Additional Funding secured by JRP partners during 1992–93*** (£ million)
Belgium	0.03	0.03	*
France	0.2	0.2	2.7
Germany	0.5	0.61	4.72
Greece	0.08	0.09	0.4
Ireland	0.06	0.06	1.84
Italy	0.2	0.2	6.3
Netherlands	0.04	0.04	*
The Nordic Countries	0.15	0.11	*
Portugal	0.14	0.42	*
Spain	0.27	0.30	1.2
Total	**1.67**	**2.06**	**17.16**

* Returns not yet available.

** This funding was secured largely as a result of earlier JRP activity.

Table II

HED[1] LINKS (1993–94) BY SUBJECT AREA

	ASOC[2]	*AFRICA*
MEDICINE	54	16
AGRICULTURE	32	14
EDUCATION	19	16
PHYSICAL SCIENCES	43	10
BIOLOGICAL SCIENCES	38	15
ENGINEERING	80	22
ENGLISH LANGUAGE	12	3
SOCIAL SCIENCES	28	16
HUMANITIES	21	1
WID[3]	1	6
TOTAL	**328**	**119**

These numbers are for actual links and do not include prospective links for which activity might be being funded.

[1] HED Higher Education Links (This is a programme we administer on behalf of ODA and is confined to the developing world).
[2] ASOC Non-African Developing Countries (ie, Asia and other countries).
[3] WID Women in Development (a priority area for ODA and other aid donors).

Table III

Education Counselling Service Overseas Student Statistics: Top 25 Sending Countries

	All subjects—UG/PG		*Science subjects—PG only*	
	92–93	*(91–92)*	*92–93*	*(91–92)*
Malaysia	8,625	7,868	886	763
Hong Kong	8,117	7,876	542	549
Germany	7,678	6,021	586	313
France	7,545	5,963	457	463
Greece	6,286	5,359	1,030	1,265
Ireland	5,977	3,834	489	451
USA	5,315	4,648	234	210
Spain	3,767	2,760	279	328
Singapore	3,510	2,899	301	270
Japan	2,691	2,316	154	133
Italy	2,398	1,893	172	181
Cyprus	2,016	1,914	93	76
Norway	1,912	1,805	63	70
China	1,543	1,702	925	972
Netherlands	1,502	1,263	157	N/A
Kenya	1,410	1,341	160	178
Canada	1,300	1,136	177	155
Pakistan	1,295	1,251	455	435
India	1,289	1,284	339	350
Belgium	1,250	1,074	103	N/A
Taiwan	1,220	1,004	358	268
Turkey	1,107	1,285	341	456
Israel	1,020	907	48	44
Nigeria	994	1,136	291	266
Brazil	941	1,007	590	615
TOTALS:	80,708	69,546	9,230	8,811

28 March 1994

Examination of witnesses

MR ROGER BOWERS, Assistant Director General, MR MICHAEL WILLSON, Head of the Education Counselling Service, and DR JOHN RICHARDS, Head of Science and Technology Department, British Council, were called in and examined.

Chairman

310. Thank you for coming to see us. We have, of course, read with interest the paper that you sent us, which was very helpful and gave us a lot of interesting background details. Are there any specific points that you would like to draw out or to highlight from it or shall we go straight into questions?

(*Dr Richards*) My Lord Chairman, we should in fact like to correct one or two figures which appear in the document.

311. Yes, please do.

(*Dr Richards*) Perhaps we may do that after today's meeting.

312. Perhaps then we may go straight into the questions. From your experience in brokering scientific collaborations, exchanges and investments, which are set out in your document, do you have recommendations for the research councils, the universities or the Government which would make such international arrangements easier to establish or more successful in the long term?

(*Dr Richards*) My Lord Chairman, perhaps I may answer that point. The British Council's main operation overseas in science and technology is generally to encourage contacts between individual scientists. We find that scientists are generally pratical people and they are clear about their own personal objectives for collaboration, certainly for the professional side of their objectives for their particular work, and clearly they are increasingly aware of institutional benefits that might accrue from their collaboration. They are also clearly aware of disadvantages that can sometimes crop up. I think that that is true also for even larger collaborations, if I may say so, my Lord Chairman, those, for instance, that lead on perhaps to the joint development of major facilities overseas. We have in our experience examples of instances where people have in fact collaborated individually and that has then led on to significant investments into the UK science base. Japan I think is the country that offers the most examples of that. There are examples of individual scientists who have collaborated in neutron scattering, for example, which has led on to the significant Japanese investment in terms of equipment into facilities. For example, the ISIS facility at the Rutherford Appleton laboratory, and there are other examples of such collaborations involving investment in the other direction. The British Council is not the only body that is involved in this particular activity. The Royal Society of course plays a major role in building such individual contacts and the research councils themselves have schemes to support such exchanges. I think that our role, where we have the resources to permit it is also to try to support and encourage that activity and to help identify initial opportunities by supporting some of the exploratory activity that might lead to further collaboration and perhaps investments in both directions. Then when bodies like the research councils become involved in the larger scale collaborations we may act as intermediaries. I think the reason that we have become involved in this work is because of our network of officers overseas, many of whom are science qualified and specifically directed towards encouraging contacts in science and technology. There are probably relatively few barriers to those individual contacts, I think, except the obvious ones of availability of time of the individuals concerned and funding to make the travel that is required. Therefore, my Lord Chairman, I think that if we were to try to provide advice to your Lordships in relation to what the research councils might do in this particular area we should draw on our existing experience of working with the research councils where we have—and again Japan is a particularly good example—worked closely with them to establish those contacts. They have helped us very much to identify priorities. We should argue that there are perhaps other countries to which such experience might be usefully extended.[1]

313. Thank you very much. In your document, of course, you have highlighted contacts with Europe,

[1] *Note by witness:* The universities benefit from bilateral and international collaboration and are generally open to it. International collaboration can lead onto increased reputation, better research output, further research and increased numbers of students and researchers from overseas. The majority of universities have International Officers and European Liaison Officers and management plans for international work. Many are effective at disseminating information within the institution and co-ordinating international contact and activity to maximise the benefit. It is important that as these become more tightly funded and business-like, university researchers find time and opportunities to make visits overseas, receive colleagues from overseas and sustain some collaborations that are unable to attract full costs. However, this is not a major problem for scientific collaboration at present.

Government can significantly contribute to the impact of bilateral collaboration by providing a favourable environment for collaboration and co-ordinating public sector interest in collaboration. A success here has been our recent relations with Japan which have been encouraged in the private sector by DTI's Priority Japan initiative, OSTEMS (Overseas Science and Technology Expert Missions, a programme sponsored in part by the DTI) and the Engineers to Japan scheme and in the public sector by the regular UK Japan S&T Round Table Talks run by the Office of Science and Technology. The Research Councils, Royal Society and British Council play an active role in those talks.

If this experience could usefully be extended to our bilateral S&T relations with other countries this would help encourage collaboration, exchange and investment. Clearly target countries would need to be carefully identified and may not yield the same level or nature of benefits which collaboration with Japan has.

Scientific collaboration with other Member States of the European Union may benefit from a similar approach. However, the availability of the EC Framework programme and mobility schemes provides an incentive for many UK researchers to seek collaboration. The Research Councils and the British Council support the UK Higher Research and Higher Education European Office in Brussels, which provides information on these EC programmes for its subscribers, drawn largely from the UK HE and Research Council research institutions. The universities and others have evolved systems to disseminate this information and often to co-ordinate applications to these programmes. This in an effective mechanism.

[Chairman *contd.*]

in particular the European Community and Japan, and you have given some interesting indications of ways in which former British Council scholars in Japan in particular have brought investment to the United Kingdom. Do you have any similar brokerage arrangements of any kind with the United States or, indeed, north America and Canada as well?

(*Dr Richards*) I think certainly with both Canada and the United States, my Lord Chairman, we have exchange programmes and primarily scholarship programmes. With the United States we have a so-called Marshall scholarship programme. It does not identify scientists particularly as a target group; it simply seeks to identify the best people who may subsequently become major leaders in their particular field.

314. Perhaps I may just ask you about the Marshall programme. In the ODA document we saw quite a bit about the Chevening fellowships and some other Commonwealth fellowships. With regard to the Marshall ones I wondered whether that was anything to do with the Marshall Aid plan. Are these for Americans coming to the United Kingdom and are they funded by the United States?

(*Dr Richards*) My Lord Chairman, I do not have the exact details of how they are funded, but they are funded with a contribution certainly from the British Council from our central grant in aid. They are for Americans coming to the United Kingdom.

315. At what kind of a level, postgraduate students essentially or people more senior, would you think?

(*Dr Richards*) I think that they are predominantly postgraduate, my Lord Chairman, people who are beginning to establish themselves in their own particular field.

316. And not restricted to any field, not specifically for science and technology?

(*Dr Richards*) Not specifically for science and technology.

317. We have noticed in the figures that you have helpfully sent us that there appears to have been a significant decline in the number of students in science and technology coming to the United Kingdom, particularly from developed countries, and an increase perhaps in some of those coming from other EC members such as Greece, but fewer coming from the United States and other countries. Is that fair?

(*Mr Willson*) My Lord Chairman, I think that that is true.[2] One of the most significant aspects of overseas student numbers has been the increase from EC countries. With regard to the numbers since 1979 when there was the change in the student fee base they have increased 15-fold since that time.[3] That is the numbers coming from the EC. They now constitute approximately one third of the overseas students coming into Britain so those numbers have gone up very significantly. I think that it is true to say that as a proportion perhaps the number of students coming from less developed countries has gone down. I think that in absolute terms it probably has not declined, but as a proportion I think that it has gone down. I should say, my Lord Chairman, that one of the papers that we should like to leave afterwards for the Committee is a slight amendment to some of the figures that your Lordships have. The orders of magnitude illustrated in the original paper remain the same, but the figures themselves we have been able now to update from some more recent figures.

318. I was particularly struck by the fact that the number of students coming to the United Kingdom from China has not diminished significantly in total but the number of those coming in science has gone down by two thirds.

(*Mr Willson*) I think that that may be true, my Lord Chairman. I do not have detailed knowledge of the market in China but I think that as it has broadened out there is now a small but significant number of Chinese students coming to this country not on government funding; they are funded in some cases by expatriate Chinese and I think that they probably will account for a large part of the broadening in the subject base of numbers coming from China.[4]

Lord Perry of Walton

319. You give a large number of interesting examples of individual grants. You classify them as sponsorships, as JRPs, as others of similar nature in these collaborative schemes and then postgraduates, taking the heads of your paper. Is there any way in which you could give us overall figures for what is the total sum in all these categories? There is no way of telling from what you have said whether you have mentioned only a bit of it or most of it. Perhaps you could let us have the figures later.

(*Mr Bowers*) We could certainly give you figures later, my Lord Chairman. I think that I should say that the submission that we have given presents only a part of the British Council's overall effort in science and technology. From our total turnover of something over £400 million from different sources our calculation is that 28 per cent of that at present is committed to science and technology of one kind or another so we can certainly give you some scales of magnitude for our investment in science and

[2]*Note by witness*: Decline of Overseas S&T students - Mr Willson's confirmation that there had been a decline in the numbers of overseas students studying S&T was based on incomplete data, in particular concerning the former EC countries. Overall, data made available to the British Council from the Department for Education and Universities Statistical Record shows there has been an increase in overseas students numbers from '91/92 to '92/93 of over 13 per cent. For the 25 sending countries only (see Table III of the written evidence), the increase has been 16 per cent. For students in S&T subjects, numbers have increased over the two years but by only a very small proportion - less than 2 per cent. This is consistent with the pattern over the last five years; numbers of overseas students studying S&T subjects in the UK represent a declining part of the overseas student population as a whole.

[3]*Note by witness*: The revised figures have amended the degree of increase (see Table III of written evidence).

[4]*Note by witness*: For Chinese students in S&T subjects - the numbers have declined by over 4 per cent between '91/92 and '92/93. However, this should be seen in the context of a decline in overall numbers of Chinese students of over 9 per cent. Detailed figures for previous years are not available for China and it is therefore difficult to identify longer term trends.

[Lord Perry of Walton *contd.*]

technology. Your Lordship's question, however, I think is perhaps about the numbers of people actually involved.

320. No, my question is this. I should like to know what the total investment is. Twenty-eight per cent of £400 million is a nice round figure but I should like to know what proportion of that is overseas investment.

(*Mr Bowers*) Indeed, and we will try to produce the figure.

Chairman

321. Thank you, that would be most helpful. Can you give us any comparisons of the number of scholarships for postgraduate or undergraduate education for overseas students in this country as against the numbers provided by, shall we say, our industrial competitors in the EC or the United States or elsewhere?

(*Mr Willson*) My Lord Chairman, the latest figures that we have for the number of British Government funded students, we term them study fellows, coming to Britain administered by the British Council in 1992-93 was 16,700. Of these just over 4,000—4,195 in fact, about 25 per cent—were for overseas students to study scientific and technical subjects at postgraduate level, at master's, doctoral and post-doctoral research levels.

322. That is helpful, thank you.

(*Mr Willson*) If we then compare that with Japan, it is a smaller scale of numbers but a much greater concentration on science at postgraduate level. The Japanese Government funded a total of 5,478 students in 1992 of whom 3,518 were studying science and of these 3,360 were at graduate school.

Lord Perry of Walton

323. And these figures are for students coming to Britain?

(*Mr Willson*) No, I am sorry, my Lord Chairman.

Chairman

324. No, going into Japan?

(*Mr Willson*) Yes, my Lord Chairman, overseas students going to Japan.

Lord Perry of Walton

325. The figures that you gave were all British Government funded?

(*Mr Willson*) That is correct, yes, my Lord Chairman.

326. Do you have figures for the non-British Government funded?

(*Mr Willson*) I am afraid not, my Lord Chairman. These are more difficult to get hold of, ones that are industrially funded or funded by universities.

Chairman

327. We should be able to get an idea of that from the University Statistical Record, should we not?

(*Mr Willson*) My Lord Chairman, our overall figures have been provided to us both by the University Statistical Record and the Department for Education. I confess that we did not ask them about the sponsorship background of students. They may have it.

328. Yes, I understand that. What we are trying to get at is how good this country is at providing funding for overseas students to come and study. Do you have any comparable figures for countries in Europe and what sort of scholarship provision they provide?

(*Mr Willson*) I have figures for Germany, my Lord Chairman, but I am afraid that they are not comprehensive in that they do not include the German aid programme whereas the figures that I gave you for the British Government include our aid programme. As an indicator, however, the nońaid German Government effort was just over 3,500 scholarships for three to 12 months for postgraduates and nearly 7,000 scholarships for postgraduate and advanced studies but that covered all fields.

Lord Nelson of Stafford

329. My Lord Chairman, I should like to be quite clear as to what the British Council see as their role in this field. Is it only one of your activities, a relatively small activity? I had rather looked on the scientific counsellors in the various embassies as being the contact for this sort of work and I should be interested about your view. Could you explain the relationship between your involvement in this and that of the scientific counsellors? You referred to the fact that your contact seems to be with research councils. You have not referred to the universities nor to industry but only to contact with the research councils. Can you explain that?

(*Mr Bowers*) My Lord Chairman, perhaps I may answer in general terms and then I will ask Dr Richards to speak specifically about the relationship with the Foreign and Commonwealth Office. I think that it is reasonable to say that within the range of objectives that we have to serve our cultural relations and development purpose, science and technology is in fact a very significant commitment. We maintain a cadre of specialist officers in the field to identify opportunities for British science and technology and for joint ventures. We are extending our commitment into export promotion, as I believe Baroness Perry will know, through the Overseas Project Board Education and Training Group and I think that I am right in saying that in every one of our corporate plan specifications of objectives that we have for regions around the world, science and technology does figure as a primary objective. It is clear that we have to clarify our own role in relation to other agencies. We certainly do not compete, for example, with the marketing initiatives that our colleagues earlier on from the universities were engaged in and we see our function very much as providing access for them to overseas institutions. However, there is a particular question about the relationship between our effort in this area and the work of the embassies, and I think that Dr Richards can bring you up to date on that.

(*Dr Richards*) My Lord Chairman, the Foreign and Commonwealth Office maintain science counsellor posts in a number of key countries overseas, Germany, Italy, France, Japan, the United

[Lord Nelson of Stafford *contd.*]

States and Russia, and the sizes of those operations vary a little from country to country. The British Council, as Mr Bowers has said, has a number of science qualified posts overseas. In fact, we have a rather larger network than that of the FCO. In some cases the role is duplicated, in other words, in Germany and France, Italy, soon Russia and Japan we have British Council science officers working alongside their colleagues in the embassy. There is always a good collaboration between the two bodies at the post in the country concerned. There tends to be a division of work between the two operations. The people in the embassy are, by and large there to report back to Whitehall departments and to report back to the United Kingdom on initiatives in scientific areas and in developments in industrial technology. They do that through the Foreign and Commonwealth Office with other departments such as the Department of Trade and Industry and the Office of Science and Technology, who are major customers for that work. The British Council on the other hand is much more directed towards developing relationships for the longer term. There tends to be more of a focus on the science base and interrelations between the science base of the host country and that of the United Kingdom, and that tends to bring us into contact much more with the research councils than perhaps with companies, although there are inevitably overlaps. Certainly in my experience academics going overseas are also interested in seeing how the local industry is approaching research in their particular areas. I think that the relationships are cemented back in the United Kingdom by the fact that the British Council is also a participant in discussions within Whitehall and with the research councils about international research priorities and activities and we do take part in any initiatives that are likely to involve science and technology activities directed internationally, specifically bilaterally; I think that we have less of an involvement in the way that the United Kingdom formulates its involvement in the European Community programmes.

Chairman

330. What do you hope will be the outcome from the review of overseas work in science and technology that is being done by Segal Quince Wicksteed for the Foreign and Commonwealth Office, the Office of Science and Technology and the Department of Trade and Industry?

(*Dr Richards*) That is an interesting example of the way that we do work with colleagues in government departments, my Lord Chairman. This particular study is owned by the Foreign and Commonwealth Office, the Department of Trade and Industry and the Office of Science and Technology although we very much have been and are continuing to be very much drawn into that particular work. The objectives for the study are to look at the work of the science and technology sections overseas, those in the embassies, but it does recognise the relationship with British Council science officers and science posts overseas. Segal Quince and Wicksteed have been asked to do one particular part of that review, which is to look at the demand side within the United Kingdom, in other words, to identify what need and what requirements industry, Whitehall and the academic community have for the information that science and technology sections and British Council officers overseas might provide or already do provide.[5]

Baroness Perry of Southwark

331. My Lord Chairman, I should like to pursue this information base matter a little, if I may. May I say how much I enjoyed your paper, and I hope that you will note that I used one of its anecdotes in an article in *The Guardian* yesterday.

(*Mr Bowers*) It had not escaped our attention, my Lord Chairman!

332. My one disappointment, however, was that there is very little quantification of the amount of industrial money from overseas which comes here. It has always seemed to me that somewhere hidden in the British Council's files abroad there must be a lot of information about overseas companies' links with British universities in particular using them as science bases and probably that is the best source of information that we shall get. Did you try to get any quantification of that sort of area when you were preparing the paper or does it exist in the British Council or is it simply separate in each national office?

(*Dr Richards*) My Lord Chairman, when we prepared that paper in fact we did consult offices overseas. We did not consult all offices, but we simply consulted those that we thought had a significant science and technology element to their work. The biggest return that we had was from Japan. There are examples in Japan of Japanese companies with such links that we are aware of and have in some instances resulted from British Council contacts or contacts initiated or supported by the British Council. One of the examples given in the paper I think was the Honda investment in the wind tunnel at Imperial. Another one that has come to my notice recently, a form of investment, is the donation of a vector processing machine[6] also to Imperial from the computer manufacturing company, Fujitsu, so there are such examples. I think that the focus of our work is predominantly on the interaction between the science bases and therefore I think that we find it difficult to form a comprehensive view of the level of commercial or industrial investment in the British science base. It ends up being anecdotal.

333. The Office of Science and Technology in fact gave us a figure in their evidence of £100 million into British universities from overseas companies. Does that gel with the kind of information that you have? Does that sound right, does it feel right, because it feels to me much too low from what one hears, again

[5]*Note by witness*: The British Council is hopeful that the study conducted by Segal Quince and Wicksteed will provide guidance that will help us improve our services. Out of the full review we expect to establish good practice for the work of both the S&T sections and the British Council science posts which will improve their effectiveness. There are examples of good practice, e.g. in Japan, where the two staffs have worked together constructively over a number of years.

[6]*Note by witness*: An advanced computing machine.

[Baroness Perry of Southwark *contd.*]

anecdotal, from individual universities? One hundred million for the whole investment in the United Kingdom university sector sounds too low.

(*Dr Richards*) If it is predominantly from the commercial sector because a lot depends on how you define investment. There is a lot of money flowing into this country as I think your Lordships have heard this morning from other witnesses. There is a great deal of funding flowing in from the European Community research technology development programme, the so-called Framework programmes, and that will be a substantial sum of money, I imagine. From the commercial sector £100 million does not sound like a great deal of money, but that is simply a guess and it is based, I think, on my assumption that in respect of countries like the United States, and the British Council has a relatively poor overview of their investment in this particular sector. There is a strong tradition of companies from the United States and also from government departments in the United States into the UK science base, specifically into universities, to conduct particular pieces of research work. I have not really answered your question.

334. The answer is that you really do not keep it in any central form?

(*Dr Richards*) No, we do not keep it in any central form. We have tried to do that for our involvement in some of the European programmes so that we are beginning to get some measure of the way that our programmes then lead on to subsequent funding by European Community programmes.

(*Mr Bowers*) My Lord Chairman, we can certainly give quite specific data on the investment returns on the research programmes such as the academic research programme in Germany, and there is clear interest in the British Council and the kind of leverage which a relatively modest investment—in that case half a million pounds—can lead to.[7] Equally in tracking the United Kingdom's record on the European research funds we have fairly sound evidence that we are actually, not a net contributor, but a net receiver of funds on the European schemes. Those are relatively easy to track. I think that the difficulty with your question is that it is coming from so many places and with no focus I think for record keeping I think except in the universities themselves.

Chairman

335. If we could possibly have information in writing afterwards it would be most helpful.

(*Mr Bowers*) Indeed, my Lord Chairman.[8]

Lord Nathan

336. As you were speaking of financial matters I wondered whether you could let us know where we might get the information about the balance of currency flows in relation to science and technology investment, how much is coming into this country as compared with what is going out?

(*Mr Bowers*) My Lord Chairman, are you thinking in terms of education and training specifically or all aspects, for example, equipment provision and things of that sort?

Lord Nathan] I was thinking of the whole really.

Chairman

337. We are primarily concerned with research in science and that, of course, is a factor in which the postgraduate student must play a role.

(*Dr Richards*) I am not sure, my Lord Chairman, that I am aware of a single source of that information. I think that an estimate probably could be achieved by some form of study to address that, but that I think would involve consulting every individual university and every research council institution to see what level of funding they did in fact attract in. The difficulty then of trying to get a measure of funding going out of the country would be even harder and would require going to each individual company. Again one begins to run into problems of definition for some of the multinational companies, for example.

338. I hope that Lord Perry will forgive me for mentioning that he has just passed me a note in which he said that one of the problems that we are going to face is that investment can be cash, labour, ideas or return on intellectual property rights. These British Council fellowships represent an outflow of cash but an inflow of talent and ideas and how we classify the various forms of inward cash investment is going to be a very difficult task; these are all things that we will have to examine. Do you believe—and this is a very small and peripheral point—that the ELBS, the English Language Book Service, makes a significant contribution in the science field, particularly in attracting overseas postgraduates, or has it been overtaken rather by developments in information technology?

(*Mr Bowers*) My Lord Chairman, I suspect that it depends which part of the world one is talking about and in the areas where we have supported information flow through the low price book scheme and through our library facilities in the developing countries I think it quite likely that information technology has made very little impact. Certainly our investment in information in the developed countries is increasingly in terms of access to the international data bases, but I do not think that that has particularly contributed to our aid work. Whether the books actually encourage people to come to Britain I should have my doubts. I suspect that the important connections are really the ones that Dr Richards spoke of.

339. Although, of course, parts of the world that were regarded as parts of the developing world such as Malaysia, Singapore and the Pacific rim where many of these books sold very extensively are now really developing very fast, are they not?

(*Mr Bowers*) Yes, absolutely, my Lord Chairman, and I think that one of the significant features of the Education Counselling Service on which we have provided information is that it has two particular targets at present in the countries in which we operate that service. One is very much those countries where there is already a very significant and stable flow of students and the other is very much in those countries

[7](see table I of the written evidence).

[8](see table I of the written evidence).

[Chairman *contd.*]

where because of social and economic development, mainly, as you say, my Lord Chairman, in the Pacific rim, we see very significant possibilities for the future.

340. Could you tell us just a little bit more about the biennial UK-Japan science and technology round table talks? How did they start, who was involved and what do they discuss?

(*Dr Richards*) My Lord Chairman, the initiative, if I can draw on my previous experience, began in 1989 as a result of a discussion between the then Foreign Secretary and his opposite number from Japan when it was agreed that there should be some form of meeting to explore opportunities for S&T contact between the United Kingdom and Japan for greater contact and also an opportunity to exchange ideas of mutual interest. The first meeting was then held in July of that year organised by the forerunner of the Office of Science and Technology, the Science and Technology Secretariat of the Cabinet Office. It was led on the United Kingdom side by the then Chief Scientist Adviser, John Fairclough[9], and led on the Japanese side by a representative from their Ministry of Foreign Affairs, Gaimusho, but it did draw in representatives from all key research and development spending departments in the United Kingdom and in Japan as well as the British Council, the Royal Society and other bodies such as AEA Technology, for example. That first meeting identified a number of areas where collaborations might usefully be pursued. That practice has continued through the two subsequent meetings, the last of which was held again in the United Kingdom in October last year. I think if I may say so, my Lord Chairman, the benefit of that process is that it does provide a loose framework for encouraging collaboration. It does provide an opportunity to exchange areas and to identify problems that might interfere with the relationship between the two countries, but it is not particularly prescriptive; it is an encouraging process and it allows the research councils and other bodies then to go away, having identified key individuals in both countries to carry forward a particular area of collaboration and it is then a question of exploring whether those are feasible and reporting back at some later stage. It is therefore actually quite a useful way, I think, in which Government can encourage collaborative research and it might be a way that could usefully be applied to other countries if that was an area of interest to the United Kingdom Government.

341. Can you give examples of any countries whose intellectual property right regimes are so incompatible with UK/EC law as to impede scientific collaboration?

(*Dr Richards*) My Lord Chairman, I think that this general barrier, if I may so say, to international research collaboration is improving. The general situation as a result of GATT and as a result of individual countries' initiatives has in fact improved considerably. I think that our concern and the concern predominantly of my colleagues overseas is that there is a perception among scientists and I think also particularly among industrialists that in some countries either the regime that protects intellectual property rights within that particular country and also protects the rights of scientists and industrialists in other countries is not entirely matched to UK interests. I think that there is a greater concern and that is that the enforcement of those regimes is also not enthusiastically pursued, if I may put it that way, in some countries and that tends to discourage collaboration in more strategic or applied areas of research and technology. Judging from accounts in the press, my Lord Chairman, I think that the situation in some far eastern countries is in fact improving very markedly and that is providing opportunities for industrial investment in those particular countries and greater research collaboration. Whether the regime is significantly improved enough to allow completely free collaboration remains to be seen. The OECD, as just one other factor, my Lord Chairman, did identify back in 1988—and all members of the OECD subscribed to this particular memorandum at that time—that this was in fact a key area which should be protected by all countries and they agreed among themselves to pay particular attention to intellectual property rights.

Lord Nelson of Stafford

342. May I ask how you see the balance of trade in this field of investment in science and technology between people coming to this country, visiting this country, and the opportunity that we are taking to invest in other countries and to what extent you see it as your job to stimulate contact both ways?

(*Dr Richards*) My Lord Chairman, I think that there are examples, again drawing from personal experience, if I may once more return to Japan where it is clear that there are number of British companies now investing and which have invested significantly in research and technology facilities within the country, ICI, Glaxo and Unilever, for example. Unilever is an example of another company that has invested in research and development facilities in India as well so I think that there are clearly examples. It is difficult to draw a balance as between the inward and outward investment involved in this particular field. I think it is clear that there are countries which are greater investors in the United Kingdom such as Japan and the United States and because they are very active in these fields they can give a greater impression of the risks or the opportunities that that provides whereas perhaps in the vast majority of the countries that the British Council is involved with there is little interest or little opportunity for those countries to invest in or to sponsor research in the United Kingdom. I think that some of my colleagues, and I think that I should agree with them, do see some of the countries again in the Far East as being potential investors in the future. South Korea is an obvious example, Taiwan may well be an example and possibly even China in the longer run. It is an issue that is clearly important and I think one that one needs to form a view about.

343. Do you see it as your job to stimulate outward investment as well as inward?

(*Dr Richards*) My Lord Chairman, I think that we are very interested in stimulating commercial interests in general. We have a programme of

[9]Now Sir John Fairclough, FEng.

[Lord Nelson of Stafford *contd.*]

encouraging trade promotion particularly relating to training and education which is an area in which the British Council has a long experience. I think that we should, if we can find a clear role for ourselves, be interested in exploring and assisting that. I think that the rationale for providing that comes from the fact that we are interested in generating sustainable relationships. It is little good the British Council putting money into exchanges if they are not then going to be followed through in the something longer term.

(*Mr Bowers*) I should add as an example, my Lord Chairman, that we have very enthusiastically supported the know-how fund in eastern Europe, for instance, and certainly a major aim there has been to create the kind of joint venture activity between companies and institutions in east Europe and Britain, including outward investment, that will tie us into greater opportunities in the future. Most of those links I think have in fact been in the areas of management and social studies rather than science and technology per se, but certainly where it is possible to use British Council resources to assist that kind of investment in the future we will wish to do so.

Baroness Perry of Southwark

344. My Lord Chairman, there is one area on which we have not touched which is the investment in research and development and, indeed, in training made by the big international funding agencies like World Bank and so on. We talked about the European fund but I mean the more commercially based ones. Do you feel that the United Kingdom is getting its fair share, if there is such a thing, of those international funds and is the UK science base itself in a sound enough position to be able to compete against the Americans, Australians and so on?

(*Mr Bowers*) My Lord Chairman, perhaps I may answer the first more general part and again Dr Richards will add something on the science and technology front. We do work very hard to secure for Britain as large a share of the multilateral aid grant as is possible. We do not think that we are achieving as much nationally as we should at the present time. A part of that has to do with the extent to which we have a secure base in terms of our bilateral aid programmes from which we can go out and seek the multilateral, and I think that that is perhaps to be pursued in other circles. I think that there is little doubt that there is more that we can be doing than we are doing nationally at present. Then Dr Richards will reply on the science base.

(*Dr Richards*) My Lord Chairman, the British Council does try to take a very active part in supporting the activities of the UK science base, particularly the higher education institutions in participation in any World Bank, EC or Asian Development Bank programmes. I think that there has been a very significant change though in general donor policy as far as aid is concerned over, let us say, the last decade where support for science and technology links or institution development perhaps in science and technology institutions in aid recipient countries has actually declined as a focus. The priorities of those donors has shifted to other areas. Perhaps I may use this as an example, in education the shift has been very much away from higher education, investment in higher education, into investment in basic education. The idea of pulling through by building a good higher education base has now declined. There are however bright spots perhaps even now in donor policies and clearly the environment and the emphasis that that is currently receiving in donor policy does provide opportunities at least for the science base operating actively in the environment and does lead on to institutional development programmes for countries. It is clear that in the environment it is necessary to have a good monitoring system within countries and to have advocates who understand the science of the environment, so I think that there is effort from the donors going into those areas. Within the ODA they are now also focusing on enhancing productive capacity. Therefore clearly we will refocus some attention on technical and vocational areas of work which would include higher education and the science base possibly.

Chairman

345. May I thank you very much for coming and being so helpful to us. We have given you some more tasks to undertake in asking for further information which we shall look forward to receiving in due course.

(*Mr Bowers*) My Lord Chairman, thank you very much for hearing us.

Supplementary memorandum by the British Council

2. *The EC Framework Programme places a premium on cross-border collaboration. Does this lead to collaborations which could not be justified solely on the basis of science? If so, is this in your view a bad thing or a good thing?*

2.1 It is difficult to comment on the quality of collaborations established under the EC Framework Programmes (FP). The British Council is not directly involved in their implementation or evaluation. Many of the relationships that are established and nurtured as a result of the Joint Research Programmes (JRP) the British Council runs across Europe in collaboration with counterpart organisations, subsequently attracting funding under the EC FPs. The JRP programmes of individual research collaboration are generally selected through a peer review system involving referees in both countries with final decisions being taken by joint committees drawn from senior scientists and representatives of national funders. Major criteria are the perceived quality of the groups involved and the research proposed.

2.2 One objective for the EC Framework programmes is to enhance European competitiveness, another is so-called cohesion—strengthening Community capacity across all Member States. In the programme of university links we run on behalf of the ODA, it is notable that many of the successful links between universities in the UK and a developing country do not involve necessarily the universities with the best research ratings. Here the objectives are developmental and the primary intention is institutional development, often in an area related to broader aid priority objectives. Whilst in principle one might wish to support the best research people and institutions, there may be circumstances where the objective of the collaboration is seeking to achieve other criteria.

3. *The Government and yourselves appear to be doing a great deal at the moment to encourage scientific collaborations with Japan and these efforts appear to be fruitful. What is it about UK science that particularly attracts investors from Japan?*

3.1 The UK has a considerable reputation for its scientific record and it is known to be particularly creative. Many Japanese researchers have good contacts with the UK. Many excellent and young scientists, in the immediate post-war era, visited the UK to conduct research and post-graduate study. Many of these were the professors of the current generation of Japanese researchers.

3.2 The factors which contribute to the UK's popularity as a potential collaborator or site for research investment may include:

- UK's record for science and scientific creativity and access to excellent British researchers and research results.
- Many Japanese young academic and Government researchers studied in the UK in the post-war era. Many have become influential and are in a position to guide their successors. Those trained in the US find similarities of research approach and systems of higher education in the UK.
- UK institutions have welcomed investment and the sponsorship of research.
- A foothold in the UK may provide access to a broader European scientific community. This is likely to be a significant factor for those pursuing commercial interests.
- The UK Government has welcomed inward investment in R&D and manufacturing. One has often led on to the other. The Government has defended the rights of local Japanese investors.
- Japanese Government policy in recent years has encouraged greater internationalisation and a shift to basic science.

3.3 Other equally important factors are:

- The English language—the second language for the majority of Japanese scientists.
- Trust and understanding.
- Low costs: salaries and living expenses.
- Free and open markets (financial system).

3.4 The most important factor is that we have the researchers with the record that they seek and need.

8. *You regard overseas post-graduate students as "a significant income for the universities" (para 3.4). Are you able to quantify this? Does it do more than cover costs? And can you say what proportion of this sum comes in fact from UK scholarships?*

The British Council is not aware of any study of the income to universities from post-graduate students. Universities would be best placed to answer this. We have always assumed that post-graduate fees do exceed the cost of teaching and we haven't heard any anecdotal evidence to contradict this. However, EC/UK student fees do not cover costs.

10. *You also regard overseas post-graduates as "a major contribution in manpower to the UK's scientific endeavour". How would you answer the view (which we do not necessarily share) that they are taking places which could have gone to British students and will return home to give the benefit of their training and contacts to competitor countries rather than to "UK plc"?*

10.1 Anecdotal evidence suggests that many research supervisors in academic and Research Council institutions and units value post-graduate and post-doctoral research workers from overseas. Although characteristics vary from individual to individual, they often have a reputation for dedication and hard work which makes them valued contributors to the institution's research endeavour and hopefully to that of the UK. Many are carefully selected if they are on some form of fellowship programme.

10.2 The UK has benefited from the contributions of visiting researchers in the past. Many have stayed on to win longer-term places in our research and teaching institutions. They have secured these places generally in competition with UK candidates and have been seen to be the best qualified and equipped person for the job. Many of the long list of Nobel Prize winners with which the UK is credited are researchers and scholars, originally from overseas. It should not be overlooked that many fund themselves, securing support for living

expenses, salaries and fees from their own Government, company or family. These people arguably augment the UK research effort.

10.3 The British reputation for creativity and originality in science was in part established by such people. They can bring different ways of approaching problems and new techniques. To quote a reverse example: Dr Kikuchi, Sony's research Director told a team of senior UK researchers, led by John Fairclough, the Chief Scientific Adviser in 1988, that he particularly valued the contribution of the young British researchers attached to his laboratory specifically because of the different approach they provided. It is significant that one young researcher is still at Sony's laboratory in Japan and now reportedly on the permanent staff.

10.4 There are longer-term advantages to the post-graduate research training provided by the UK to overseas students. Many return to key research and scientific posts in institutions and government in their home countries. They provide a natural point of access for British colleagues and often achieve senior posts in due course. These "returnees" find themselves in the academic and research world, Government services and industry, often in opinion forming and decision making positions. Their influence is difficult to quantify outside anecdotal evidence but one should be cautious about under-estimating it.

10.5 There is little or no evidence to suggest that overseas post-graduates are taking places that might otherwise be filled by UK students. In August 1992, the SERC published a comprehensive analysis of research personnel at British universities (the then polytechnics were excluded) led by Dr Harry Atkinson, then a Director at SERC. This study made an excellent analysis of the otherwise complicated data for the period 1980–1989. As part of the study, an analysis of the number of research students, their subject areas, nationality and source of funding was completed. This showed that:

- the total number of research students (full time) has grown over the period from 22,789 to 26,858 (by 18 per cent)
- four-fifths of this growth has been in students from outside the UK, with numbers rising from 8,200 in 1980 to 11,443 in 1989
- the number of EC students has doubled (from 701 to 1,579)
- the numbers of Commonwealth and other overseas students have also grown but less strongly, the former rising from 2,517 to 3,225 (by 28 per cent) and the latter from 4,982 to 6,639 (by 33 per cent). Note that the number of other overseas students peaked at 7,302 in 1988.

10.6 By subject areas from 1980 to 1989:

- The number of research students (ft) in Medicine has grown by 33 per cent (from 1,864); in Science by 29 per cent (from 9,593) and in Engineering by 22 per cent (from 3,803)
- However, the number in Other subjects (including the Arts) has fallen by 2 per cent
- The numbers of UK Nationals have risen in Medicine (from 1,132 to 1,604) and in Science (6,728 to 8,516) but have remained roughly constant in Engineering (1,872 to 1,842 with a slight rise to about 2,100 in intermediate years)
- In Engineering the percentage of UK Nationals in 1989 was only 40 per cent and the percentage from outside both Europe and the Commonwealth was also 40 per cent
- In Other subjects, the proportion of UK Nationals has fallen by nearly a third from 4,857 to 3,454. By 1989, UK Nationals formed only 47 per cent of research students in these subjects.

10.7 The Research Councils together fund less than 40 per cent of all post-graduate students and over the 80s the percentage fell. Research Council funding for post-graduate students from other EC member states has risen rapidly from a low base (fees only) but this is less than 1 per cent of the total number of post-graduate students funded by the Research Councils.

10.8 This implies that there were sufficient places for adequately qualified UK nationals, as there was growth in their number in science subjects and medicine. The numbers did not increase in Engineering subjects but overseas students filled this gap in demand. Engineering professors have reported that it was difficult to find UK research students to take the awards (often provided by industry and other non-research council sources). However, there is clearly demand from overseas for post-graduate research training in engineering.

19 April 1994

WEDNESDAY 20 APRIL 1994

Present:

Dean of Beswick, L.
Nathan, L.
Nelson of Stafford, L.
Perry of Southwark, B.
Perry of Walton, L.
Porter of Luddenham, L.
Selborne, E.
Walton of Detchant, L. (Chairman)

Examination of witnesses

Professor D C BURKE, Vice-Chancellor of the University of East Anglia, DR K J R EDWARDS, Chairman, CVCP, Vice-Chancellor of the University of Leicester, and PROFESSOR B E F FENDER, Vice-Chancellor of the University of Keele, from the Committee of Vice-Chancellors and Principals, were called in and examined.

Chairman

346. May I ask whether you wish to make any opening statement on behalf of the CVCP?

(*Dr Edwards*) Thank you. There are just two points that I should like to make at the beginning. The first is just a general point about university academic life and research; that is, that knowledge is international and universal and research must be global. That is the general atmosphere in which we like to work. The second point is that we have developed over recent years many activities in collaboration with other countries, whether it be recruitment of students, particularly research students, or collaborative work in research. At least that has been partly a reflection of our universal attitude to knowledge, but partly a reflection of the exhortations from the Government about diversifying the sources of our income and maximising our non-government income. So that has been an important component of it. Beyond that, perhaps we could come back to a question and answer session. I do not think that there is anything else that we particularly want to say at this stage.

347. Do you believe that the university sector is to be seen as an invisible exporter? If you accept that role, does it come into conflict with the main mission of the universities, or is it complementary?

(*Dr Edwards*) First of all, as a straight answer to the question about whether we are an invisible exporter—I think we are. We have a considerable volume of activity and some of the figures are available. Perhaps I could say at this point that we would be happy to provide, in a written submission afterwards, some illustrations of the figures that we talk about. That might be quite helpful. So we certainly do see ourselves as an invisible exporter. I do not think that we see it at all as in conflict with our mission. It depends of course on what kind of activity we are doing. For example, if straight, limited terms contract research overwhelmed our ability to do basic research, it would be in conflict; but that would apply whether the support for that work was coming from Britain or abroad—it would not matter. I do not think we see it as in conflict; rather we see it as complementary.

(*Professor Burke*) Perhaps I could just add to that. Looking to the future, this nation's income must surely be driven by its ability to use its brains and its technical skills. People come to the British universities because they are in the world market and are attracted to us. We feel that it is a compliment both to the universities and to the people who work in them.

Lord Porter of Luddenham

348. There are, surely, two exports that you can claim to be making. One is the export of results from research and the other is the export of educated people. Is that right?

(*Dr Edwards*) Yes, indeed.

349. Are not both of them sending knowledge of one kind or another abroad?

(*Dr Edwards*) Yes. The export of educated people, whether they are PhD students or post-doctoral workers, is probably as big, if not a bigger, source of transfer of ideas and knowledge compared with the commissioned research work that might be done.

Chairman

350. When we began our enquiry there were those who suggested that certain massive investments from overseas, as for instance those by US pharmaceutical companies in certain universities, might carry the risk of distorting priorities within the university sector. We have been generally reassured that that does not happen. Is that your perception?

(*Dr Edwards*) It is my general perception, yes.

Lord Dean of Beswick

351. You talked about people from overseas coming here. But my information is that the numbers are diminishing and that people who traditionally used to come here are now going elsewhere because of the high charges that are now being levied. Is that correct?

(*Dr Edwards*) I do not think that at the moment there is very much direct evidence that that is happening. There is a concern that it might happen. Certainly within the universities there is a concern. It is not so much the high charges but the general squeeze on the finances of the universities, which means that although our fees are not out of line with other countries, the facilities that we are able to provide for overseas students may be less attractive than they are in some other countries.

[Lord Dean of Beswick *contd.*]

352. The domestic students have lost about 25 per cent in real terms. That must have an effect on the input financially, must it not?

(*Dr Edwards*) Yes. The figure of 25 per cent perhaps could relate to the reduction in real terms in the unit of resource, the unit of support, per student coming from home and the EC students. Obviously that is reflected in the general provision of facilities, staff:student ratios, library facilities and so on on our campuses as a consequence. That would apply to the overseas students as well.

(*Professor Burke*) They pay a much higher fee, of course, which is in the world market. We market our postgraduate courses, whether at master's or doctoral level, abroad—for example in South East Asia. We have to meet competition from Australia and the United States. So we have to offer a product that is worth their paying for. In general, we have been able to compete.

353. But is it not also the case that the universities are now expected to deal with an ever growing number of students without having a commensurate increase in central finance?

(*Dr Edwards*) That is certainly true. That is the figure of 25 per cent or so over the past five or six years.

354. Does that indicate that you are, in a sense, trying to push the ball uphill?

(*Dr Edwards*) Yes, that is a way of putting it that I would recognise.

355. You are generally losing out in terms of how you can compete with people from abroad. That must be so, mustn't it?

(*Dr Edwards*) That is a concern to us, indeed.

Lord Perry of Walton

356. You would not regard overseas undergraduates as an investment in UK science, would you? Postgraduates undoubtedly are an investment, which comes from contributing to research. But would you regard the income from overseas undergraduates as an investment in our research?

(*Dr Edwards*) No, I do not think I could. But there is great value in having overseas students anyway and the income certainly in recent years has been extremely valuable to us in the general running of the universities.

357. I do not argue with that. Of course it has. But we are looking at the investment in science, are we not?

(*Dr Edwards*) Yes.

Baroness Perry of Southwark

358. I should like to turn to the competitive nature of the business, which is fresh in my mind because I am just back from Malaysia and Singapore on a selling mission. Could I press our three witnesses to talk a little, first, about whom they see as our competitors in attracting inward investment in research, and then what they see as our particular advantages and disadvantages in selling UK science as something in which people from overseas ought to invest? What do you see as the things which inhibit their wish to invest and perhaps send them to other countries? And what do you think are our particular strengths to sell?

(*Professor Fender*) Perhaps I could answer that question in two parts. First, I think we have to recognise that there is a quite rapid globalisation of research everywhere. I should like to quote to you from an article in the *FT* of March 17th, which refers to the American investment of R&D, and in particular that: "Funds committed [in the States] to R&D abroad have soared; they rose ninefold between 1985 and 1991, while the amount spent in the US has stagnated". The article goes on to make the point that this is a general phenomenon and that both Europe and Japan are investing more in R&D in other countries. Just looking at the growth in the figures alone may not tell the whole story, but then you come back to ask what attracts that inward investment in research. I think that the answer is very simply people. The evidence is that those who are serious about research—most companies and I think not just large companies—do have a facility to seek out who are the experts. I shall give you one example from Keele. We have a data engineering group and the professor is the only member of a group drawn from Europe which the Japanese invited to participate in a big ten-year programme. They hunted him out from 100 universities—from the whole of Europe, as it were—to identify the team that they want to work with over the next ten years in data base engineering.

Chairman

359. We have been assured, partly from the United States, that the investment in this country is related, to some extent, to a change in the Government's attitude in the USA towards licensing arrangements over there which has allowed companies to invest more overseas. Nevertheless, you are right in saying that 40 per cent of investment from the USA and from Japan in R&D is coming to the United Kingdom. So this country has done very well. But it is being suggested to us that there are growing disincentives, which may be a cause for concern, and not least the fact that departments in science and engineering in UK universities are becoming less well found in relation to the quality and range of the equipment that they can provide. Is this an anxiety?

(*Professor Fender*) I think that it has to be an anxiety. I think that we would be foolish not to say that there was a concern there. It is not just about equipment, though clearly that is important. The survey done by the ABRC, which showed our relative investment in equipment particularly with respect to national laboratories, is still fresh in our memories. But I believe that some of the recent initiatives by the research councils have helped people to see the relationship between equipment and people in a way that leads to greater investment. The other concern is the question of the time of the principal researchers. That is where there is a link with teaching and the earlier point about the erosion of real funding for the whole of the university sector, because the main body of research in universities is still done by the teacher-researcher. We are getting cleverer at releasing people for time and cleverer at appointing five-year special fellowships and so on. Nevertheless, the teacher-researcher remains the driving force. The pressures on that teacher-researcher give you a worry

[Chairman *contd.*]

about his or her freedom to be able to conduct research of a kind which will attract overseas visitors.

Lord Porter of Luddenham

360. May we just be sure about the answer to your question about less well found laboratories? We are talking at university level here. Would you say that the Japanese universities have better found laboratories than the British ones?

(*Professor Burke*) Not in my experience.

(*Professor Fender*) I cannot indicate that at all.

(*Professor Burke*) But we are competing with North America and the US in particular and with continental Europe.

Lord Porter of Luddenham] The point about the Japanese is that they have splendidly found laboratories in industry. That is the difference. We are talking about universities. So we have to watch what we say about less well found laboratories.

Chairman

361. We have now been told that even in the Pacific rim, in places like Singapore, Hong Kong and Korea, the quality of equipment in those countries in many universities now has improved out of all recognition. Is that something about which you have evidence?

(*Dr Edwards*) It is limited first hand experience. From that I would say that that would appear to be generally true.

Lord Porter of Luddenham

362. But starting from a very low base perhaps?

(*Dr Edwards*) Yes.

Baroness Perry of Southwark

363. And without the people who know how to exploit it. The second part of my question asked: what are the non-selling points? What are the difficulties that we have in attracting inward investment? Perhaps the problems that you have been talking about are part of that. Are there things to say about the image of British science? One of the things that was said to us in Singapore was that we have less of an image of working closely with industry and on strategic research in this country than perhaps they would wish. It was an idle comment and I am not even sure that it was justified.

(*Professor Fender*) I am rather surprised by that. It depends on whom you make the comparison with. In terms of Europe, I would have thought that we were well ahead and comparable with the United States.

(*Professor Burke*) And in terms of what we were doing 20 years ago as well. There has been a significant culture change in the universities in the past 20 years. When I was a very young man, certainly, it was seen almost as going to the opposition to go to work in industry—and I am a chemist, or I was then. That is certainly not true any longer.

Lord Perry of Walton

364. Could I ask whether the pressure of teaching is the main reason why the teacher-researcher to whom you referred has less time? Or is the pressure of administration and writing research job applications almost as much responsible?

(*Dr Edwards*) They are both relevant. The big change has been in the demands for teaching, because the student numbers have risen so dramatically and the staff numbers have not matched them at all. I suspect that there is also more administration. That is another issue that we sometimes complain about.

(*Professor Burke*) Perhaps I can pick that up. The changes that are taking place in the way that the university is running because of the expansion are indeed relevant. We at UEA, for example, have just moved this current year from a traditional timetable to a common timetable for the whole university, in a way that the whole system is moving. I have been quite concerned about the amount of time taken from research to do this—a change which is necessary in order to deliver as good a product as we can at a lower price for a large number of students. So it is not just direct teaching; it is learning to live with twice as many students in the same amount of laboratory space and so on.

Chairman

365. What has been the effect of the selective funding based upon the research assessment exercise?

(*Dr Edwards*) My initial reaction would be that it has helped us to concentrate. I think that all the universities, and certainly the three universities which happen to be represented here, have been moving toward focusing their research programmes in order to have as well supported as possible specific activities and focused activities.

(*Professor Fender*) Yes, there is that aspect. It is the professionalisation of research, which the selectivity exercise has encouraged. I think that is a good thing. It has certainly improved the output. I do not mean that it is just an improved productivity measure. But it has encouraged people who have done the research to write it up and share it with the rest of the world. I believe that the effects of the research selectivity exercise up to now have been almost wholly beneficial.

366. But is the system sufficiently flexible to allow the bright young person in a so called "T" department, who has got research potential, to develop his or her skills so that the grading of the department could ultimately change?

(*Professor Fender*) My experience is that departments are very sensitive to that grading and therefore collectively now do quite a lot to free up the good researcher. But the concern is a real one. It is a long, traditional concern about the balance between teaching and research at the level of the individual. It is not just the fact that there are more students to teach. It is that the whole teaching and learning process is now an exacting one. Teaching assessment carries with it its own bureaucracy. It may have some merits but they are less obvious than in the research selectivity exercise, I might say, by a long way. So the teacher-researcher is attacked from both sides. I marvel at how much they manage to achieve—I must say, by working on Saturdays and Sundays. But we must be aware that that pressure is on them.

(*Professor Burke*) I have some concerns about the able person going to a university department or cost centre with a rating of below 3. I would not advise an

[Chairman *contd.*]

able young person to do that. I think that the risk to their research career is substantial. So what we are seeing—and we see examples in our three universities—is a diversification of the universities. We are becoming quite different from each other. Leicester's strengths and Keele's strengths are different from East Anglia's strengths. I do not think that that is a bad thing, so long as we retain enough strengths in any particular discipline in the United Kingdom (and in some areas we are getting close to the edge). The professionalisation, as Brian Fender referred to it, has sharpened us all up.

Lord Nelson of Stafford

367. I can see the advantage to the universities of having overseas undergraduate students because of the funds that they bring in. But does that not rather defeat the situation which you have outlined? Does it not put additional pressure on the teachers and therefore distract them from their research activities? I can tell you of a personal experience—and it does not reflect on any of the three universities represented. My grandson is doing an engineering degree at one of our leading universities and he has found the greatest difficulty in getting any supervisory time out of his lecturers. That indicates that either they are all far too busy doing research or that they have far too many students, of which many are foreign students. Is there not a disadvantage in having so many foreign students as well as a monetary advantage?

(*Dr Edwards*) But the monetary advantage means that the average income per student to that department is rather higher than it would be without them, because they are paying full-cost fees. They are paying high fees.

368. But that does not enable them to employ adequate staff to see that the students are properly supervised, does it?

(*Dr Edwards*) The number of staff would be much smaller if they did not have the overseas students and had only the home students—much smaller.

(*Professor Burke*) Perhaps there is a point to make here; all three of us would feed back a substantial proportion of those higher fees to the cost centre or the department which was doing the teaching. In our case, the individual cost centres decide how many overseas students they want and that is part of their budgetary exercise. They decide how many they can teach, how many they can recruit and how many they can cope with in the laboratories, looking at the income. If I may say so, your grandson would be worse off if there were not any overseas students.

(*Professor Fender*) He would perhaps not have a supervisor at all.

369. So is the balance of advantage in favour of everybody, not only the universities but our own undergraduates and our own scientific researchers as well?

(*Dr Edwards*) Yes.

Chairman

370. Do you see a case for any central or regional service to assist universities in attracting, negotiating and managing international investment? Or do you think that it is still best left to individual researchers and their universities? Are there cases where such arrangements, to your knowledge, have gone wrong?

(*Dr Edwards*) The general case, I think, is that there is scope for assistance of that kind. My own feeling is that it is probably best on a regional basis. My experience personally in the East Midlands is that it is very early days yet to say how the new East Midlands Development Office is going to work out. But there is some assistance there and it is being helpful to us. It probably could be considerably fuller and better. But that is the kind of help that is useful. They can also deal with some of the general issues of the infrastructure that investment requires: accommodation, services and so on. My own view is that that is helpful on a regional rather than a national basis. But there is a good case to be made for that kind of assistance.

371. Do you think that so called "teaching companies" established by universities have developed links with local development corporations which might help in this process?

(*Dr Edwards*) I do not have any personal experience of that.

(*Professor Burke*) Well, ours have not developed such links. We live in a rather under-populated region and that is one of the attractions of East Anglia. The focus of the development corporations is rather elsewhere. It is maintained in the small towns. We have not had such positive help.

Lord Porter of Luddenham

372. To what extent do you encourage the individual researchers of whom we are talking to go out and negotiate international investment? One way of encouraging them would be to ensure that they personally had a reward, which is not unattractive to a young researcher. To what extent do you give them freedom to go out and try to negotiate for themselves? First of all, do you agree that they are very important in doing this? They have their own personal contacts overseas without any doubt. But what policy do you have within the university for somebody who does negotiate such a contract?

(*Professor Fender*) I am sure that practice varies quite a bit from university to university. I can illustrate mine. The individual going out is all important. That is where the research contact will be made. I should have thought that institution to institution approaches were rather few and far between. I pick you up perhaps on the point of negotiation. It is much better to have the negotiation done by professionals. We have a research support unit—and Derek Burke indicates that he has too. I understand that many universities now have a support department which is professionally staffed and they will do the negotiation. They will try to extract the maximum amount of overhead and generally make sure that the research funding is adequate before even recommending it and approving it.

(*Professor Burke*) I would agree. Intellectual property is the other issue on which, if I were a young person, I would want to have an expert alongside.

373. You are thinking there of the university, information and everything else. But I am still asking the question about the student. What incentive does he have? Obviously he has noble thoughts about his

[Lord Porter of Luddenham *contd.*]

university and his country, but what personal incentive do you give him?

(*Professor Burke*) I have rather an unusual example, not from the physical sciences but from the social sciences. We have a School of Development Sciences in the University of East Anglia which specialises in the training and education of people for the developing world. In that university department there is a company—the Overseas Development Group—to which all members of that department are contracted for one third of their time. The contracts come in from the World Bank and allied NGOs. This company, run from a university department, has a board of directors and an annual general meeting. But in addition—to make your point—it offers significant additions to salary to those people who go to work in Nepal or South East Asia etc offering their skills. So there are ways which are developing of combining both the academic service with personal reward. I find it is best if those decisions are taken close to the point of delivery and away from my office.

The Earl of Selborne

374. Dr Edwards told us that he thought that there was probably a case for regional assistance to help inward investment—international investment. Would you like to comment on the national and local infrastructures which help the development corporations? To what extent do you, as a customer, responding or asking the development corporations to respond to your requirements, find that the present structures are adequate? For example, at the moment we have impending local government reform which maybe creates a confusion or maybe helps. Would you like to comment on how central government and local government relate to the development corporations?

(*Dr Edwards*) Certainly in Leicestershire the imminence of the recommendations of the Local Government Commission is causing great difficulties. Effectively, there is a blight on getting decisions made by local authorities at the moment. Hopefully, that will be a short lived phenomenon. I think that there is difficulty in that there are so many different authorities involved in making decisions. There is the development corporation looking to the region and then with the two tier system that operates in Leicestershire and elsewhere there are difficulties about coordinating the decisions, about planning matters, about road infrastructures and about the assistance to investment with so many different bodies. I would not claim to know the answer to that, except that one hopes that there would be good collaboration. But at the moment there is a problem about encouraging overseas investment even in research and development, let alone in manufacturing.

375. I wonder whether any of the three witnesses have ever had cause to try for structural funds from the European Union? This is some way removed from normal university activity, but it is something which logically follows from the development corporation exercise.

(*Dr Edwards*) I have no experience of that help.

Chairman

376. Do the Training and Enterprise Councils play any role of significance in that regard?

(*Professor Fender*) They might play more in the future but they play rather little in my experience at present. One of the difficulties is that of not having in England very clear regional guidance. I believe that is a great disadvantage. As you look more and more closely at the links between higher education, the community and the region, you see that there needs to be some policy about it. There are big fluctuations, for example, in the funding. If you take the money that goes from the Higher Education Funding Council for England and look at that spend per head of the population on a regional basis, you find big variations throughout England with only one region, the South-East, matching the per capita spend for Wales and a number of regions which are 50 per cent below that Welsh/South-East England level. Within that—because I am not talking about big regions—if you take my little patch, then the fraction of spend per head of the population would be less than half of that in Wales. It is hard to understand that. Correspondingly, it means that the sensitivity to the contribution that higher education can make to the economic life of the region is a bit dulled.

377. You did not mention Scotland.

(*Professor Fender*) No. I might almost call Wales a region, but I would not dare call Scotland a region.

378. I fully appreciate that point. There are significant differences between funding for higher education in Scotland compared with England, are there not?

(*Professor Fender*) To be positive, I think that we should try to forge a partnership between higher education and the region which encourages both manufacturing investment on the one hand and research investment on the other. The two go together.

Lord Nelson of Stafford

379. Do you really want to establish the principle that the universities are regional universities? I thought that they were all national universities.

(*Professor Fender*) No. That is one of the problems. People want to put you in one camp or another. I am very clear that we are a very local university, we are a regional university, we are a national university and, in some respects, we are an international university. We operate at all levels.

Baroness Perry of Southwark

380. You gave me a lead into my question by talking about regions. I have become very conscious, in looking again at our competitiveness compared particularly with the USA which is our biggest competitor in terms of investment in research, that the Americans are very good at acting as consortia, as groups of universities competing together. So the kinds of strengths to which Professor Burke referred earlier, which are now becoming very differentiated in universities, are being offered as a package, so to speak—you can pick your particle physics from one, and so on. Are there enough initiatives among universities to work together? The impression is of individual universities each competing for its own bit

[Baroness Perry of Southwark *contd.*]

of the action and sometimes, if I may say so, quite disastrously attempting to offer something which they are less strong in instead of passing on the business to a more competent neighbouring university. Could you comment on that? It seems to me to be very crucial to our future competitiveness.

(*Dr Edwards*) I think that a consequence of the way in which the funding mechanism has been operating in recent years is that we have seen ourselves as extremely competitive. There are examples of collaboration. But this will take place if both parties agree that there are considerable joint benefits. There is a synergy involved. It requires a deliberate effort to make. If it is for the benefit of the two institutions in competition rather than for the benefit of the community or region that will stimulate that, given the particular situation that we have. A few years ago what was then the Universities Funding Council took some steps toward setting up regional structures and regional committees and so on, but that fell apart. It was overtaken by the other pressures on the system. We do need to have some sort of positive incentives to do that in a variety of ways, both in research and in teaching, which would stimulate this. Then, I believe, we would get more collaboration between the universities within the region that had impact on the economic activities of the region.

Lord Dean of Beswick

381. I should like to return to the question of development corporations and local authorities. Historically, the different tiers of local government right across the board have been known for their dislike of one another. There are massive examples of non-collaboration, irrespective of which political colour is involved. Dr Edwards, you gave me the impression that a university which is very close geographically to a development corporation may well be in a more advantageous situation financially than one that has no such corporation near it. The corporations have been more kindly treated by central government in funding than have some of the tiers of local government. So we come back to the basic fact that you are advantaged in a university where there is a powerful development corporation, such as perhaps the one in the centre of Manchester or in one of the big cities—as you said, a national university—but some of the universities with a wider spread could be operating at a disadvantage. Am I right?

(*Dr Edwards*) There have certainly been advantages to the universities in Wales, for example.

382. Wales is a special case because they get more of everything. The fact is that in per capita spending Wales gets over 20 per cent more in terms of its population; and Scotland does better still.

(*Dr Edwards*) I do not have personal experience of the system in England and of how well that might have operated. I guess it probably has been advantageous in Liverpool, for example.

(*Professor Burke*) I think that there has been some help with student housing; projects where it was to the advantage of the university and the community. I cannot think of an example in the research area.

Lord Dean of Beswick] I think UMIST in Manchester did some housing with them.

Chairman

383. There are other regional advantages. My former university in Newcastle had very powerful links with some of the local industries, which funded, established and endowed Chairs for a variety of things. So there are regional links which are crucially important.

(*Professor Fender*) Coming back to the investment in science, generally, what surprised me is that there is very little variation between universities right across the country, including Scotland and Wales, in terms of the proportion of their research income which comes from overseas. It is around 10 per cent or 11 per cent for the country as a whole. Most universities are very close to that figure. Cambridge, Sussex and Leeds—to take three very different universities—have the same proportion of overseas money.

Lord Nelson of Stafford

384. Are you differentiating between funds which come for undergraduate training and funds for research?

(*Professor Fender*) I am talking about funding of research in universities.

(*Professor Burke*) And, if I might just blow my trumpet, we are a little higher than the average. Let me make a general point from that. I believe it is because we have a very highly regarded and rather unusual School of Environmental Sciences with its Climatic Research Unit. The general point is that when you have something that the market needs and it is good, you can use it.

Lord Perry of Walton

385. We talked about the pressure of the increased number of undergraduates, both home and overseas students, and the pressure of the reduced unit of resource which militated against the ability to attract research money from overseas. It is therefore arguable that if there were an increase in staffing, there would be an increase in the investment of overseas money. Would the two balance? Could a case be made for saying that if you give more money for the staffing, there will be such an increase in overseas investment that it will more than counterbalance it?

(*Dr Edwards*) I would certainly like to believe that that was true, but I doubt that I have the evidence for it.

(*Professor Burke*) It would be an interesting experiment which one could set up with quite modest amounts of money over two or three years, with specific milestones and goals for additional funds to be raised. It is a straight business decision. I think it is a very interesting idea.

(*Dr Edwards*) It would be interesting to see this as a pilot in particularly chosen departments where the business plan suggested that there was a clear potential for generating investment.

386. Might it cause a lot of jealousy in other comparable departments?

(*Professor Fender*) You could do it through the funding council mechanism. It would be interesting to have an overseas "R" factor—in other words, an

[Lord Perry of Walton *contd.*]

incentive generally for universities which had attracted overseas money.

(*Dr Edwards*) But this is prospective. This is putting in money in order to bring money back from a business plan proposal. It might be a useful vehicle if you wanted to achieve that.

Chairman

387. Shall we leave that thought with you?
(*Dr Edwards*) Yes, that is an interesting idea.

Lord Nathan

388. Reference has been made to the development corporations. It has been put to me that in Wales, for instance, great efforts have been made to introduce television and electronic centres with great success. Prior to that, we as a country had stood very low in the manufacture of items of that kind. It has been put to me that, as a result of that investment there have been two consequences. One is that we are among the top people in that field of television and its components as manufacturers in this country; and the consequence of that has been an impact on the research element that stimulated research and, by implication, university scientific activity in those fields. Do you consider that is a reasonable analysis? If so, then there is a direct link between the development corporations and the stimulation of industrial activity in this country and the development of science and overseas investment in science in the universities. I should be interested to know whether you think that is right.

(*Professor Fender*) I do not think that it works that way. Most of the modern industries, the growing industries, are research led. So you have to start with the research activity and then try to spread it out into the area round about and therefore attract manufacturing. I do not believe that you would get the reverse process unless it was by chance that a firm which had invested for manufacturing purposes had got into the habit of coming into that area and suddenly realised that there was research potential there which previously they had overlooked. So the spread of manufacturing may in very general terms facilitate the spread of research, but I do not think that there would be a causal connection.

Chairman

389. May I be sure that we do not overlook one or two rather important points? First of all, have you any comments to make about the animal rights problem and the threat of terrorism? Also, do you have any comments about whether regulatory or other non-science factors, as for instance EC or EU directives, have any influence upon looking for overseas funding for research?

(*Dr Edwards*) In answer to the first question about the restrictions on animal experiments, I do not think that there is any evidence of which the CVCP is aware and we have no evidence, as individuai vice-chancellors, that that is an inhibitory factor. On the question of regulations, obviously this does not put us at a disadvantage compared with other Members of the European Union; but we are certainly conscious of the costs of dealing with all the regulations. I am not sure that it is a direct disadvantage but the indirect problem of the increased costs is a difficult one for us.

Baroness Perry of Southwark

390. Particularly in biotechnology, would you say?
(*Professor Burke*) Perhaps I might comment on that. We occupy an intermediate position between the rather more *laissez-faire* attitude of the United States and the more restricted and regulated atmosphere of France, Germany and Holland in particular. I am a member of the Advisory Committee on Genetic Modification. We have been concerned that in this country we should not get swept away by an over-regulated approach from Brussels. I think that that could disadvantage us *vis-à-vis* the United States. There has been a quite overt policy on that committee and another on which I sit to try to carve out a policy which was reasonable, safe and acceptable as a lead policy for negotiations in Brussels, in order that we might take the lead in negotiations there rather than be driven by other parties. On the whole I think that has been reasonably successful.

Chairman

391. You mentioned intellectual property rights. We learn that several universities have established very formal procedures, and even new companies, to exploit these. Are there any general guidelines from the CVCP to universities on how they should handle this? Do you approve of the kind of formula arrangement which many have introduced?
(*Dr Edwards*) There are some guidelines—advice, certainly. But individual universities do make their own arrangements.

392. Does any of them operate a United Kingdom preference or overseas premium policy?
(*Dr Edwards*) Not that I am aware of, no.

393. They are standard formulae, whether the money comes from the United Kingdom or overseas?
(*Dr Edwards*) We do the best deal that we can, yes.

394. Let me follow that up. It is some years since I worked in a university, certainly in research, but it used to be required by the CVCP that a 42 per cent overhead should be chargeable on commercial contracts. Is that still your recommendation or do you now allow universities to charge bigger overheads, should the opportunity arise?
(*Dr Edwards*) We certainly encourage universities to charge much bigger overheads on commercial contracts. We have some advice on how to calculate that so that it covers the full cost. It is a matter for the individual universities to determine in any particular contract exactly what overhead they wish to charge and agree to.

(*Professor Burke*) We have a procedure which means that any overhead below a certain figure—around 40 per cent—has to go across my deputy's desk in order to ensure that the advantage to the university in carrying through the work is sufficient to outweigh the loss of overhead; and there are such cases. On the other hand, as Dr Edwards says, if we can push 100 per cent or 110 per cent, we do. We have been pushing it up steadily year by year. The CVCP and the HEFC have figures which demonstrate that.

Lord Nelson of Stafford

395. Is the universities' approach to overheads based on putting forward a cost which they think would be competitive, or is it based on what their individual costs are in fact?

(*Dr Edwards*) It is based upon an assessment of what the costs are; that is to say, sharing out all the overhead costs of running the university in relation to a particular research project and calculating that as a proportion of overhead that needs to be charged, usually on the salaries that are being paid for apart from the contract.

Baroness Perry of Southwark

396. Presumably there is a base, which the individual universities also have to consider?

(*Dr Edwards*) Determining the negotiated agreement in any particular contract, clearly is essentially a market decision. I was describing the way of calculating what the full costs were. That is the advice that is offered by the CVCP.

Lord Nelson of Stafford

397. But you do not have a policy that universities must charge their full overhead costs?

(*Dr Edwards*) No.

398. They have that flexibility?

(*Dr Edwards*) Indeed.

Lord Perry of Walton

399. Do you think that the overheads that are being charged do in fact meet the costs, or is it a drain?

(*Dr Edwards*) I think that there is a considerable subsidy on many contracts, but that is a decision to be made. Professor Burke referred to the need for the university to have some internal mechanism to ensure that it is not too low. But it is a matter for the university and the department jointly to decide about the work that they want to have done, which is part of their general programme that they want to do anyway, and there are additional funds that come in to help them. In that sense it is an academic and a market decision.

(*Professor Burke*) The culture is changing but it has not been helped by the assumption until quite recently that government departments did not need to pay overheads in universities and many British companies felt that they had already contributed through taxation to the support of universities. Overseas companies spot that and expect the same treatment. We are trying to change perceptions. The university facilities are not free goods and one way or another they have to be paid for.

Chairman

400. We have been assured by the Office of Science and Technology that the transfer of funds from the university budget to the research councils was related only to grants from the research councils. There is a widespread perception in many university departments that that has not worked and the money is not coming back from research council grants as had been anticipated. I should like to know whether universities generally or selectively are now charging overheads to charities, for instance, including charities from overseas?

(*Dr Edwards*) The first point, the perception that the money has not come back, relates to the level of grant for individual projects. There is a feeling that the research councils are distributing the money in more projects at a lower level than would have been covered originally by their grant plus the matching grant from the funding council. So I think that is a concern. It is more that, say, salaries that are paid for directly by the funding council are being covered but there is less in the way of money to support the work of those people who are employed as post-doctoral research assistants and so on.

401. My second question was about overheads on grants from charities, whether United Kingdom based or overseas.

(*Dr Edwards*) The big medical charities are still taking a very strong position that they will not pay overheads. Overseas charities do, and that is a matter for negotiation.

Lord Porter of Luddenham

402. I have been worrying about something that Professor Fender said. If I understood correctly, it is remarkable that the universities are extremely uniform in the funding that they get from overseas grants and so on and you said that it was about 11 per cent. You chose three universities in particular—Cambridge, Leeds and Sussex. Firstly, yes, it applies to them, they are all three good universities. But would it apply across a hundred of them? It worries me that, if that is the case, it would seem not to follow our own British assessment where the universities are funded to very different extents from the research councils and so on. Do the overseas investors not look at the grading of the universities and the university departments? Is that really true? If it is, it means that there is nothing to fight for. We are all the same. I think I must have misunderstood.

(*Professor Fender*) No, not entirely. One point to make is that I am talking about pre-1992 universities. I am not including the new universities in this exercise. Secondly, I am talking about a proportion. So the total research money is very different in the three universities that I mentioned. But it seems to me an interesting observation that even the smaller universities are equally active in raising overseas research investment. That is the point I am making. I think that Derek Burke has given us an illustration of that. Across the pre-1992 universities nearly all have some strengths. Those strengths are capable of attracting inward investment. That is a very encouraging sign, it seems to me. We are not just talking about a few centres which have the capacity to attract international money. We are talking about all or nearly all the research based universities at least. I do not have the data for the new universities.

Chairman

403. The total sums are very different but the actual percentage of total research income is fairly even across the older universities. Is that right?

(*Professor Burke*) The general point that we would like to make is that for the band of universities which we represent, which means the universities of, say, 5,000 to 8,000 in size with a substantial research income, those universities are as active per person as some of the much larger universities. Volume is not the only measure of quality.

Lord Perry of Walton

404. Earlier in the discussion, you offered to let us have figures. Could the figures referred to by Professor Fender be made available? They would be very helpful.

(*Professor Fender*) We can also produce a graph which might be even more helpful.

Baroness Perry of Southwark

405. Is it your view that that 10 per cent is about right, the maximum that could be obtained, or could it be increased or doubled? I think it represents about £100 million, does it not?

(*Professor Fender*) It is £130 million now.

406. Is it your view that that could be or should be increased?

(*Professor Fender*) We should be aiming for 20 per cent. That is my personal view.

Chairman

407. There is one major concern that has been expressed to us from many quarters. We have heard that science in British higher education institutions is of a very high quality, although some unevenness is obvious, and that there is a great deal of inventiveness available in our universities. But UK industry, unlike overseas investors, tends to take a short-term attitude toward the exploitation of the products of science and technology, whereas overseas investors are more willing to take a long-term, strategic look. For that reason, it is also said that industrial or financial partners are not easily found in the United Kingdom and are more easily found overseas. Do you believe that that is so? What can be done about it and will Technology Foresight help?

(*Dr Edwards*) I shall pass the question to Professor Burke who is very much involved in the Technology Foresight exercise.

(*Professor Burke*) As a director of BTG perhaps Professor Fender would like to say something first.

(*Professor Fender*) It is a very big question. We may need to write to you.

(*Professor Burke*) I have some experience which fits in with your general observation coming from the technology company that the Cancer Research Campaign runs. Their experience is that in the biomedical field the smaller North American companies are quicker to make decisions and are prepared to take more risk than companies in this country. They have encountered some criticism because some of their discoveries have been licensed overseas. The CRC view is that licensing brings income and since we are talking about the health of a nation, so we cannot be held up. But we live in a culture—I am sure the committee has heard it before—which is more averse to risk than is North America. So any innovative schemes which make it possible to accept a little more risk on the part of the staff, by seconding them out to a start-up company for a while or by some fiscal means to help young companies to take a little more risk, would be worth thinking about. A second point I might make as a member of the Technology Foresight steering group, which has a very clear objective to pull together as best we can the resources of the United Kingdom and research and development and manufacturing for the advantage of the country. It is not a shift toward applied research; it is a coordination. It does not necessarily mean that manufacturing will take place in this country, because we are a trading nation, but it is a much more determined effort than we have seen in the past to get the various parts of the technology interaction process on the table. You will probably know that panels have been set up with a substantial industrial contribution—more than the majority and with bright young research people involved. They are being asked to tell us what we ought to do so that we can do better. I look forward to it.

Lord Nelson of Stafford

408. Would you agree that one of the reasons that the American companies are prepared to take more risk is that the potential market is very much greater and they can get their money back very much more quickly?

(*Professor Burke*) Yes, of course.

(*Professor Fender*) It is, of course, a complex issue and good science and bad application is far too simple an answer. But the British Technology Group experience is a pointer. The British Technology Group uses British inventions by and large. Increasingly they are using material—inventions—which come from overseas, but most of it is from Britain. Yet 85 per cent of their income comes from overseas. The world is a big place and you would expect quite a lot of the income to come from overseas. But 85 per cent suggests a certain reluctance on the part of UK industry to be adventurous in picking up new inventions, licensing and developing them.

Chairman

409. And is there a shortage of venture capital as well?

(*Professor Fender*) In the biotechnology area, as I am sure the whole panel is aware, when you do comparisons between the United States and Britain in terms of starter companies, you find that there is a very stark contrast between the large number in the States and the small number here, even when taking population and GDP into account.

Lord Nelson of Stafford

410. Am I getting the right message from the vice-chancellors that they are firmly convinced that it is to the national advantage to have that overseas research in British universities?

(*Professor Fender*) Yes.

(*Professor Burke*) Yes, But we need adequate safeguards. If you spot some problems and things that we ought to do that we are not doing as well as we should do, we will be glad to know.

Chairman] It has been a fascinating discussion. Thank you very much indeed for sparing the time.

Letter from the Natural Environment Research Council

In reply to your letter of 3 February, I am able to respond to your requests for answers to the three questions in advance of the Sub-Committee's main call for evidence.

Prior to answering these questions, I believe that it is worth re-stating our position on International Science, which was briefly referred to in Dr Paul's letter of 5 January to Dr Rodger.

The environment spans national boundaries and it is not surprising that most of the research funded by NERC, both in its institutes and in the universities, is carried out within an international framework and, often, overseas. This will continue to be the case for the foreseeable future. There are a number of advantages from international S&T cooperation. First there is cost-sharing. Secondly, there is the ability to share facilities and obtain access to specialist facilities which may not be available otherwise. Thirdly, it facilitates access to data and encourages data exchange. Fourthly, it may provide the opportunity for access to remote or restricted field areas. Finally, there is the intellectual stimulation which stems from contacts with researchers from other countries.

We pursue this international research through formal bilateral and multilateral associations and, most importantly, through informal contacts at the scientist to scientist and the laboratory to laboratory level. We give positive encouragement to the development of international scientific links. The important point to note is that these research collaborations are based on national scientific contributions which have won their funds through peer review and related "filter" systems and are programmes of high domestic priority. As such, they are often self-sufficient but ones to which international collaboration can provide an added value.

There are international aspects of almost all programmes in every scientific sector for which NERC has responsibility and scientists in other countries will have an interest in these programmes.

Question 1: *In what sectors within your remit are you aware of particular international involvement in UK science?*

It is difficult to define "involvement". If this means an interest or collaboration, then there is international involvement in all sectors. If this means funding, then this is essentially limited to our overseas programme unless funding by the European Commission is taken into account, when this also touches all sectors of the environmental sciences. However, EC funding could be construed as domestic funding as it is drawn from the UK contributions and those of the other Member States to the Community's budget.

Question 2: *What is the extent of international involvement by the NERC itself?—whether by means of NERC supporting work done overseas, NERC institutes doing work for overseas interests, NERC and overseas interest co-funding work in the UK, or other means? Please distinguish as far as you can between overseas interests of a commercial nature, those of public-sector nature, and international collaborative programmes.*

The initial statement (see above) sets out the extent of the international aspect of environmental research supported by NERC.

Within our responsive mode support for universities via grants, studentships and fellowships, the extent of international involvement and collaboration is a matter for individual applicants. International connections are not a guarantee of funding, which is dependent on the quality of application, as determined by peer review, and the priorities of the proposals as determined by the Grants Committees. Statistics are not collected on the actual research grant spend related to international science as this would be difficult and costly to achieve. One measure of the extent of international involvement by NERC supported work in universities is the proportion of overseas fieldwork costs for research students as against the total cost of studentship support. In 1993–94 overseas fieldwork costs were £350k out of a total fieldwork provision for students of double this figure.

NERC institutes are active overseas to varying degrees. Much of the work is funded by the Overseas Development Administration (ODA) and, as such, is UK funding of overseas work as part of the UK aid programme. In 1993–94, it is expected that this funding will amount to £6.89m out of a commissioned research budget of £41.19m and a total budget for NERC of £181.27m. At 3.8 per cent of the NERC total, it is a significant funding item. The ODA funding provides opportunities for access and for research that would be unavailable, otherwise, to institute researchers within its primary objective of meeting the needs of the developing country in receipt of aid.

In addition to ODA funding, NERC institutes carry out work *overseas* for a variety of bodies including overseas governments, UN and similar inter-governmental agencies, Development Banks and private industry. Examples of the funders of such research are the US Department of Energy, the US Office of Naval Research, the Governments of Hong Kong, the Falklands Islands and Lesotho, the UN World Meteorological Organisation, the UN Food and Agriculture Organisation, the World Bank, the Asian Development Bank and private industry. Although, in most instances, this work is funded at full economic costs, it is underpinned by research carried out within the UK Science Budget and could be construed as *joint* funding of overseas research—a case of NERC and overseas interests co-funding work done overseas, which

is a category not included in the question. Again, the advantages of these arrangements are in providing opportunities of access to regions and data which might otherwise be unavailable, to develop and widen the research experience and portfolio and to develop new collaborations with researchers from other countries and from other sectors.

The degree of involvement in overseas work of this nature is variable between institutes dependent on the role of the institute and its scientific specialisms. Examples of the pattern of involvement between the funders identified above are given in Appendix 1.

The EC is a major funder of collaborative research in the UK. A fundamental aspect of most EC funding is that it involves collaborative arrangements involving institutions in at least two Member States and, for Research Council institutes, there is a maximum of 50 per cent funding, hence the term "shared-cost action". Overall, NERC is one of the largest contractors to the European Commission with income in 1993–94 estimated at £4.69m (2.6 per cent of the total NERC budget). In addition to EC funding, NERC is a contractor to the European Space Agency.

International funding of research in NERC institutes in the UK is small and is concentrated, principally, on provision of fellowship support for work at our institutes. For instance, we have a CRAY Computer research fellowship at the Institute of Oceanographic Sciences Deacon Laboratory, we host research fellows supported by the EC Human Capital and Mobility programme and we have activities such as workshops funded by NATO, the EC and similar organisations. Data on international funding of such activities is not collected separately.

Apart from work carried out for private industry overseas, the contractual arrangements which I have described are of a public-sector nature. As I have explained, international collaborative research arrangements involve the bringing together of nationally-funded programmes to produce an added value from such collaboration. This is distinct from the contract funding of overseas work described above.

The major international collaborative research arrangements to which I refer tend to be within the area of global environmental change research and NERC programmes link closely with those organised under the umbrella of the WMO/ICSU World Climate Research Programme and ICSU's International Geosphere-Biosphere Programme. In the Antarctic, our programmes are coordinated with those of other nations through the Scientific Committee on Antarctic Research (SCAR) mechanisms. NERC is a key contributor to the Ocean Drilling Program (ODP) and its new research programme on ocean-ridge processes is part of an international umbrella project (Inter-RIDGE). These examples illustrate the way in which national contributions to research, funded by NERC, mesh into the international scientific structures.

Question 3: *What is the position of intellectual property created through NERC funding or in NERC institutes? Is there any restriction against such intellectual property passing overseas?*

In the case of NERC supported research in universities, the Council does not retain intellectual property rights (IPR). NERC encourages the fullest exploitation of potentially valuable results for the benefit of the public, the host institution and, subject to conditions laid down pricipally by the institution, to the principal investigator. In the case of the NERC-funded programmes within our own institutes, IPR rests with NERC. For contract research, IPR ownership is dependent on the terms of each contract.

In the case of research commissioned by Government Departments, NERC endeavours to retain or, at least, share in IPR rights in order to maximise their exploitation. In EC funded research, ownership is shared among the partners involved.

NERC policy is to endeavour to exploit IPR potential of its research to its maximum potential. There is no restriction restricting this to UK-owned or UK-based companies, although, in practice, the large majority of exploiting parties are within the UK.

I hope that this response answers your queries. Together with the initial letter from Dr Paul, I believe that we have answered both the questions raised by your letter and those contained within the Sub-Committee's call for evidence.

If you have any further queries on this information please let me know.

8 March 1994

Appendix 1

Examples of the balance of research funded overseas or by overseas interests.

	(£k)	1992–93	1993–94
1. *Institute of Hydrology*			
a. ODA		1,915	1,776
b. EC		217	389
c. World Bank etc		5	16
d. UN Agencies		38	25
e. Overseas Governments		54	161
f. Private Sector*		202	92
g. NERC-funded international projects		254	370
2. *British Geological Survey*			
a. ODA		4,710	4,043
b. EC		544	598
c. World Bank etc		47	270
d. Overseas Governments		164	223
3. *Institute of Terrestrial Ecology (North)*			
a. ODA		336	369
b. EC		169	299
c. Private Sector		106	68
4. *Institute of Oceanographic Sciences Deacon Laboratory*			
a. EC		439	609
b. Overseas Governments		742	274
c. Overseas support for UK activities		—	13

*Often collaboration with private sector interests which have been funded through aid and development bank schemes.

Examination of witnesses

Professor J R KREBS, Chief Executive, and MR A E S MAYER, Head of International Section, Natural Environment Research Council, were called in and examined.

Chairman

411. Professor Krebs, would you like to make an opening statement on behalf of NERC?

(*Professor Krebs*) Perhaps I may briefly remind the members of the committee about the NERC. I am sure that you are already familiar with it, but I shall just go through the basic points and try to be brief. As you know, NERC is a multidisciplinary and interdisciplinary council concerned with all aspects of the natural environment. I would call them the four elements of earth, air, fire (by which I mean living material) and water. We deal with the four elements on a planetary basis. We deal with the question of how the planet Earth as a whole works and within that, more specifically, how the United Kingdom as a natural system works. We are concerned with the natural environment as a source of resources for human exploitation and we are concerned with the reciprocal interactions between Man and the natural environment. We do that with a budget from the OST of £155 million for the year 1994-95, and which we supplement with about £40 million in contract money. We are just short of £200 million in our total budget for the present year. I shall not go into the details of how the money is divided between the different areas, but I could elaborate on that if you would like. I shall make just two points. One is that, in terms of our contracts, our major customers are the government departments. 38 per cent of our contract money comes from government departments and, within that, the ODA and the DoE are our major customers. In relation to your particular enquiry today, I have tried to look at what proportion of our budget goes on international work. It is difficult to give you a precise figure, but I would estimate that somewhere between 30 per cent and 40 per cent of our budget is spent on work that has an international flavour. If you ask me why we spend that proportion on work with an international flavour, I would say that there are really three aspects to it. One is, as we are all aware, because environmental problems, by their very nature, are very often global. If we are concerned with climate change, with the carbon cycle, with ocean currents and with biodiversity, etc. We have to treat these as global problems. The second point is that, in our basic research in the universities and in our institutes, sometimes particular issues—scientific questions—can be answered better by studying them overseas. For example, in the area of biodiversity, one of the key questions is why the tropics are more biodiverse than are temperate zones. To understand the answer, clearly you have to look at tropical and temperate zones together. Sometimes our technologies are applicable overseas: we do quite a lot of work

[Chairman *contd.*]

overseas based on technologies that we have developed within the United Kingdom. Thirdly, we spend a proportion of our budget on international programmes, such as ocean drilling and the World Oceans Circulation Experiment. We see it as part of our job and part of the United Kingdom's job to be a contributor to those important international programmes. That is the third reason why we are involved in overseas work.

412. Thank you. That is very important and set out very well in Eileen Buttle's paper. We are more specifically concerned in our enquiry with money that is coming into the United Kingdom from overseas for research. There is a point that I should like to clarify with you. In Appendix 1 to that paper are listed the Institute of Hydrology, the British Geological Survey, the Institute of Terrestrial Ecology (North) and the Institute of Oceanographic Sciences Deacon Laboratory. Are those all NERC institutes?

(*Professor Krebs*) They are indeed, yes.

413. We see the investment—the very large investment—that is set out under the first three institutes from the ODA. May we take it that the figures that relate to the World Bank, overseas governments and so on relate specifically to income from overseas which is supportive of your research?

(*Professor Krebs*) Yes, you may.

414. So, for our statistical purposes, we can extract those figures from your paper.

(*Professor Krebs*) Yes.

Lord Perry of Walton

415. If you add all the figures for one of those institutes, is that the total expenditure?

(*Professor Krebs*) No, that is not the total budget of the institute. There is core funding from the science budget and then there will be contract work, for example, from the DoE, MAFF, the DTI and UK industries. Nor is it the sum total of NERC's incoming moneys from overseas. These are representative cases. Perhaps Mr Mayer would like to elaborate.

(*Mr Mayer*) Let me quote just one figure for the British Geological Survey. Its budget will be £17 million, made up of income from all sources including the science budget. What we have itemised here is the overseas funded research or overseas interest in that programme. The four institutes were given as our leading examples. The other institutes may well have some overseas work but to a much less degree.

Chairman] For our statistical purposes, it would be extremely helpful if you could manage to let us have the income from all overseas sources and the total budgets of each of these institutes, for example. That would be very helpful.

Lord Porter of Luddenham

416. With regard to the income from overseas, in your case it is mainly from overseas governments, is it not? Is there much from overseas industry?

(*Professor Krebs*) There will be some from overseas industry, although it is largely from overseas governments. Let me give you one example of a large contract from the US Government. That was a project to map the 200 mile economic exclusion zone off the coast of the United States, using the sidescan sonar. This was an £18 million compound contract from the US Geological Survey. We see that kind of contract extending to a number of other countries as they wish to map their potential wealth off their coasts. Because these are very big projects and projects that do not have a particular ownership, they tend to be government supported.

Lord Dean of Beswick

417. You mentioned a contract with the USA. Is it not a fact that the USA was the only major country which a few years ago refused to sign the International Deep Sea Mining Convention? It was the only country that opted out. Has that affected the situation in any way? I do not think that the situation has changed, has it?

(*Mr Mayer*) I think at the time when the Law of the Sea Convention was developing there were more countries than the USA which opted out at that stage. But this certainly did not affect that particular contract. Rather the reverse, they wanted to know what was going on.

418. I was on the standing committee for the Bill that dealt with the issue. I am quite clear that at the time the only major power which decided not to sign was America. Other people were frightened that there would be a rip-off because they had the resources to do the maximum that was possible at the time. Everyone else was in a different league depending on the resources that they had. Has that militated against the situation, or has it gradually been subsumed and dealt with?

(*Mr Mayer*) We have certainly not seen any evidence of that. The keenness of the Americans to have a complete assessment worked in our favour, in as much as we had the only tool available.

419. They would use anybody—wherever the resources were?

(*Mr Mayer*) Yes.

Lord Nelson of Stafford

420. Bearing in mind that environmental questions are by and large global, I am rather surprised that your participation—if I understood properly—in international activities only represent 40 per cent of your activity. Could you explain to us what determines that figure? Is it the resources that are available to you? Do we participate to the extent that we should, relative to other countries? I shall quote one example of a situation in which I was involved on a previous enquiry into marine science. At that time there was terrific concern that we were going to opt out of the deep sea drilling programme because funds were not becoming available. That rather indicated to me that your international activity to a major extent may be dictated by the funds that are available to you. But it still only represents 40 per cent of your activity, you say. Can you amplify that?

(*Professor Krebs*) The first point is that the 30 per cent to 40 per cent is an approximate estimate. Many programmes have both a national and an

[Lord Nelson of Stafford *contd.*]

international element and it is hard to unpackage them. If we look at comparability with other countries, in one area I can give you quite precise figures as a percentage of GDP. In our polar activities, we are comparable with the other major European countries: France, Germany and Italy. In fact, we spend a slightly higher percentage of our GDP on polar research, but we spend less than the United States.

Chairman

421. Does Japan spend money on polar research as well?

(*Professor Krebs*) They do, but less than us. We could come back to polar research if you want but it is quite a special case. The question is how we allocate funds to national versus international projects. In responsive mode funding to the universities, the criteria remain, as they have been up to now, primarily those associated with scientific excellence, timeliness and pervasiveness, although in the future we shall have to take into account the utility of the research. In our Community research programmes, which are directed research elements in which the community generates an idea and then we form a programme—some of our major ocean research, like WOCE—the World Ocean Circulation Experiment, would be an example of that—there is competition between the different elements of NERC, between the different disciplines, to mount community programmes. We take into account the persuasiveness of the scientific case and its applicability. There is competition in a number of different ways between different areas of NERC which do not specifically map on to the national versus international scene. We are looking at the science rather than the location of the science. If we deem that the World Ocean Circulation Experiment is a better bet than land use in southern England, it is so deemed on the basis of the scientific appraisal plus its applicability rather than whether it is national or international.

(*Mr Mayer*) I should just like to add that it is then a national programme, justified on its scientific quality, which is contributing to an international endeavour. It then has the added value of associating all of those national programmes.

Lord Nelson of Stafford

422. Are you telling us that you are dictated to by funds or, as you might say, by need? Take a particular national interest like the wealth of the oceans, which engages a considerable number of programmes of one sort or another. Are we participating to the extent that we should do, bearing in mind our interest in those fields?

(*Professor Krebs*) I think that a marine scientist—an ocean scientist—will always like to get more money. We have a limited budget. We could always use more money but within that limited budget we have well devised mechanisms, very good mechanisms, for assessing the relative merits of different programmes. The marine and ocean sciences have done very well in NERC over the past 15 years. They have increased the proportion of the NERC budget that they have obtained, thanks to very well organised programmes produced by Dr John Woods, who has been the Director of Marine and Atmospheric Sciences in NERC.

The Earl of Selborne

423. I should like to explore a little further the opportunity that your institutes may have in the future to attract increased funding from overseas governments. It occurs to me that everything emanating out of Rio in 1992 must be good news for your market. You have national action plans now being produced by over 150 countries on biodiversity, climate change, Agenda 21, and the like. Each national action plan by definition presumably must start with an inventory of the resource and then determine what will be done about it. Clearly, with your institutes, you must be in a strong marketing position to help provide such national action plans. Do you see this, therefore, as a great area and are you marketing yourselves?

(*Professor Krebs*) We already do so. This would be primarily in the terrestrial and freshwater area, but also in relation to marine biodiversity. We have marketing sectors in our institutes. I do see this as an opportunity for the future. I am concerned—this may be slightly tangential but it is pertinent to your question—about the possible change of status of our institutes as a result of the scrutiny that is now going on. The great strength that we have in the NERC institutes is that they have a reputation not only for the highest quality science but also for impartiality. They are at arm's length from the government departments in their non-departmental public body status and they have a reputation for continuity. Much of the work involved in measuring environmental change, including biodiversity change, requires long-term stability. We will have an opportunity to take advantage of the explosion of interest in biodiversity internationally as long as we retain these elements of impartiality, stability and excellence in science.

424. We must follow this point up. Clearly, we are being given a very important piece of advice here which we cannot ignore. I do not wish to put words into your mouth, but it sounds to me as though you are concerned that some, perhaps all of your institutes might find themselves more closely involved with government departments than would be good for their competitive situation or indeed the quality of their science.

(*Professor Krebs*) Obviously that is a very serious concern for us. We do not know how the scrutineers will end up in their report, even though there are less than two weeks to go before they produce their first recommendations. But to give an example, as most of your are aware, last Friday's version was that our marine institutes, excluding the Oceanographic Laboratory which will become part of Southampton University, Plymouth, Proudman and Dunstaffnage are, under the latest recommendation, to be assigned to the Scottish Office.

Chairman

425. Is Plymouth part of Scotland?

(*Professor Krebs*) I could go to great lengths on the pros and cons of that, and mainly on the cons. But that kind of recommendation would clearly undermine the scientific quality, impartiality and long-term stability of—in that case—our marine environmental science. But it would apply with equal force in the terrestrial and freshwater areas. So it is an issue of very great concern to us at the moment.

The Earl of Selborne

426. Let us look at it specifically within the terms of reference of this committee and international investment in UK science. Do you believe that, because your institutes effectively are funded through the OST, it gives you a status in the market for overseas government contracts which is less likely to be available to institutes or laboratories funded by government departments?

(*Professor Krebs*) I asked the institutes what makes them effective in getting money in from overseas and they gave me four elements in their answer. I have mentioned two of them. One is the quality of their science. Clearly they have a high reputation. BGS, IH, ITE, the Marine Institutes and so on have international reputations and people are willing to come to them for research and advice. The second element is the impartiality and continuity that stem from their being at arm's length from the Government. The third is that the institutes have effective marketing processes. For example, in BGS they have regional marketing officers specialising in Latin America and also dealing with the Far East and Africa. They go on road shows. They take around their wares and give presentations to governments, to the World Bank, and to other funding agencies overseas. The final element is that through their science and their role in training they develop links and contacts which are crucial to getting contracts in any place, not only in the United Kingdom but overseas. The fact that their scientific quality allows them to train scientists from other countries is essential in forming those links which last a long time and allow them to get international contracts over a longer basis.

Chairman

427. That is very helpful. Could I clarify one point of policy? I should like to know how your policy compares with some of the other research councils. For example, when many years ago I was on the MRC, there was a policy that the MRC units came under review when the time was approaching for an outstanding director to retire. In many circumstances, unless there was very high priority given to the continuation of the research of that unit, it would then close and its premises might well be used for another priority area in research. Is the same policy adopted by NERC, or have most of your existing institutes been in existence for a very long time?

(*Professor Krebs*) First, we have ongoing reviews or ongoing scientific audits on roughly a five-year cycle. When it comes to the case of retirement of an institute director, we would not normally expect to close the institute or change the direction, although the new director may have his or her own particular initiatives. That does not mean necessarily that our institutes are static. As I mentioned, we have been evolving our oceanographic work and we have what I believe is very innovative collaboration with Southampton University—the joint venture of the Southampton Oceanographic Centre, which will house our Deacon Laboratory from Wormley. We do undertake change, but not quite in the way that you are suggesting.

Lord Perry of Walton

428. The institute is multi-disciplinary but it is the single disciplinary unit that is reviewed. Is that it?

(*Professor Krebs*) As the MRC units, yes.

Chairman

429. That is a good point. I did not mean the national institute for medical research, for instance, or the oceanographic research centre, I meant the individual units.

(*Professor Krebs*) Certainly in the case of our units—we have one coming up in Sheffield in a two or three years' time, the Unit of Comparative Plant Ecology. I shall be asking the question of whether we should continue that when Professor Grime retires.

Lord Perry of Walton

430. They are built round individuals, then?

(*Professor Krebs*) Yes.

Chairman

431. In a previous investigation by a sub-committee of the Science and Technology Committee of this House, looking at biotechnology, there was evidence to suggest that regulatory mechanisms, particularly in the EC (which is now the EU), were in some respects detrimental to investment in certain aspects of biotechnology. No doubt you are continually faced with the activities of the environmental lobbies. What is your perception of that position?

(*Professor Krebs*) In NERC we have a small but very active biotechnology presence at the Institute of Virology and Environmental Microbiology in Oxford, in which Professor David Bishop and his colleagues are developing biopesticides, genetically engineering viruses to control agricultural or forest pests. We are faced with the regulatory problems and in that sense we share the concerns of the BBSRC. Looking at it in the other direction as to how environmental regulations from the EC and EU affect our research, in a sense they provide us with an opportunity because both UK industry and the UK Government, in wishing to respond to environmental regulations from Brussels, need to have a sound scientific base. Part of that sound scientific base for, let us say, understanding the effects of acid rain and where it comes from, is provided by NERC's research. So in that sense we are helping the Government and UK industry. Those sorts of regulations are an opportunity rather than a hindrance to us.

432. We must not lose sight of Lord Selborne's point. In two weeks' time, you say, you will learn of the outcome of the current review of your institutes.

[Chairman *contd.*]

Would you be kind enough to let us have the information - that is, any information about the outcome of the review which is not confidential?

(*Professor Krebs*) I believe that the information so far has not had "confidential" on it.

433. If it has not, would you please let us have it?

(*Professor Krebs*) Yes. I think that is so.

The Earl of Selborne

434. I think that the Select Committee will be taking an interest in this matter next month. I am sure that we shall be coming back to Professor Krebs.

(*Professor Krebs*) It is a very important issue for UK science.

Lord Porter of Luddenham

435. I thought I detected some concern when we were discussing that with Professor Krebs. Did I get the impression that you were somewhat concerned about the longer-term science being funded? Would it be true to say that funding by overseas government agencies tends to be to solve short-term problems? Do you get assistance from those funds to look at such things as acid rain and particularly long-term problems such as the carbon dioxide and ozone layer problems? Or are they trying to use you to solve their own problems quickly and therefore not helping you along with your science as much as you would like?

(*Professor Krebs*) Let me respond first and then ask Mr Mayer if he has anything to add. It is a general problem—if you can call it a problem, in the sense that you raise it—for both our national and our international contract work. On the whole, it is short-term problem solving: using the R&D base that we have generated through our OST activities to solve short-term problems. I know that one of our ambitions over the next few years is to work hard on obtaining sponsorship for generic research as opposed to contracts for problem solving. At the moment it would be fair to say that we do not have a large element of sponsorship for generic research.

Chairman

436. We have been told in other fields in particular that there are many overseas investors bringing money into this country who are prepared to take a long-term strategic look at basic research without an immediate requirement for a return, whereas UK industry tends to be more concerned with short-termism. Excellent UK science is sometimes exploited abroad because of lack of industrial or financial partners in this country. Do you have any examples of ways in which that operates in the United Kingdom?

(*Professor Krebs*) I could give you a couple of counter-examples of where we have had rather successful collaboration with UK industry. One goes back to the issue of monitoring the sea bed. I talked earlier of the sidescan sonar that has been used for mapping the economic exclusion zone off the United States. There is a newer device, called Deepscan 60, which is being developed by a small firm called Ultra Electronics in collaboration with the IOSDL (the Institute of Oceanographic Sciences Deacon Laboratory). It is a sidescan sonar system which has potentially a large market. It is just reaching the stage of being marketed. The first one has been ordered. I think that they are £300,000 each. That is a case where the expertise of the NERC institutes in data handling for ocean exploration has been put together with a small to medium UK company in a successful, longish-term development. Another case would be the Institute of Hydrology collaborating with ICL, which was originally a British company and is now a multinational, in an longish-term development of software modelling of hydrological systems for things like flood prediction and flow rate prediction. Those are a couple of cases where some contribution to development of basic and strategic science has been achieved by collaboration with UK industries, though, as I said, on the whole I think that UK industries are concerned with short-term solutions and getting us to solve problems. But we have not seen the industries from other countries, in our particular case, having a longer-term view.

(*Mr Mayer*) I do not think that I can add very much to that. In terms of ODA work. Clearly again it is relatively short-term; but it builds up a body of knowledge that we are able to exploit continually.

Chairman] That is very encouraging. Let us hope that that particular company continues to market and develop that equipment. We have so many examples to the contrary. For instance, in the biomedical field, CT scanners were invented and marketed first in this country. All of them, all those in the world, were made in the United Kingdom and now none is made here. The question therefore is about the follow-up of these inventions. That will be crucial.

Lord Perry of Walton

437. Could I return to the international research programmes which we talked about earlier and to global problems? We pay a share into an international project and many other countries are possibly paying a share greater than ours. Obviously we gain in terms of the knowledge that comes out of the project and the research work and we stay within the field. That is exploitable. Do we gain at all in inward investment for our science as a result of these international endeavours?

(*Mr Mayer*) Perhaps I could just recapitulate. We are generating our own national programmes that are contributing to the international programmes such as the International Geosphere-Biosphere Programme. The benefit there is that we have been deeply involved in the science planning of that overall international programme. Hopefully it reflects very much British scientific priorities. Our programmes then add in with France, Germany, the USA, etc., and we are getting the added value from that knowledge. But it is very much a national contribution to an international programme. It does not generate an inward investment in that sense. I think that we are all putting together our pieces of the jigsaw: the Americans are funding their programmes and we are funding ours, but there is commonality across them and knowledge is feeding across the whole of that particular scientific community. It does not relate directly to inward investment other than

[Lord Perry of Walton *contd.*]

the access to a greater body of knowledge which we can develop in different ways and exploit. It is not a direct investment.

438. So it is an investment in terms of knowledge but not of cash?
(*Mr Mayer*) Yes, indeed.

Chairman

439. How do you handle the intellectual property rights arising out of inventions derived from such activities?
(*Mr Mayer*) In most of those global change programmes, the principal output is scientific knowledge and scientific papers. They are going into the open literature. Issues of IPR do not arise. I cannot think of an IPR issue in relation to global change programmes.

440. Do you have a policy in relation to the equipment that has been developed? What is your policy on IPR in relation to that?
(*Professor Krebs*) I shall give an initial answer and then ask Mr Mayer to come in. Within the university sector, the IPR relating to NERC funded research resides in the universities. In the institute sector, we do have an IPR policy and would expect to gain some financial benefit from the exploitation of our information.
(*Mr Mayer*) We exploit that principally by licensing, where it is appropriate. Usually we do that on the basis of contracts, and so we are principally looking at licensing usually to local SMEs.

441. Do you have a standard formula for your institutes?
(*Mr Mayer*) We try to retain IPR where possible. Obviously, on contract research you are in a negotiating situation in relation to who actually owns the IPR.

442. We have been told that United Kingdom ecological scientists working overseas have a high reputation for making practical and pragmatic contributions to the host country. Is that your experience?
(*Professor Krebs*) Perhaps I could best answer by giving some examples. I picked out three areas. In the biological area the United Kingdom has a very long tradition, perhaps dating back to our days of having an empire, of work in the field of biological control using natural enemies, predators and parasites, to control agricultural pests. We are still very active in that field. At Imperial College there is a centre for biological control, which is closely affiliated with our own NERC Interdisciplinary Research Centre for population biology. To give some recent examples, they have been involved in the control of conifer aphids in Malaysia and the control of weeds both in the Far East and Malaysia and a number of African countries. One of the points of their work is that they use the underpinning NERC science of understanding the population dynamics of these pest species to select potential predators or other enemies that could control the pest populations without providing an ecological hazard in itself. We know that the literature is littered with cases where a biocontrol agent has been introduced and turned out to be a pest itself. There was a recent television programme on cane toads in Australia, which is an instance of that. The Imperial College group take a very deep view of the ecology involved so they can avoid those kinds of hazards. Briefly to touch on the area of water and hydrology, IH has recently been involved in negotiating a contract between Lesotho and South Africa for South Africa to use water from Lesotho for hydroelectric power, in figuring out how much they have to pay for it and what will be the effect on the flow out of Lesotho. The Institute of Hydrology has provided the expertise and a pragmatic solution. In Hong Kong they provided a real time flood prediction system, so that when the flash floods that happen in tropical areas occur, the local officials know when it will happen and can take appropriate evacuation measures. In relation to geology, to mention a third area, BGS has recently been involved in Malawi in identifying areas where the Malawian Government and local industry could exploit clays for making bricks, suitable sand for making glass for local industry, gypsum for making plaster, particularly medical plaster, and graphite for making pencils and for other functions, in batteries and so on. So there are many examples where ecologists, taken in the broad sense of both biologists and physical scientists, have provided very pragmatic solutions for other countries. That is one of our great traditions. We are not only excellent in our basic research but we can see practical solutions to problems.

Lord Perry of Walton

443. Do these services bring money directly to NERC?
(*Professor Krebs*) They bring money directly to the institutes. The trick there—and this is the institutes' rather than my job—is to generate enough money from these contracts to do more than simply support the contractors themselves. Otherwise, you will be locked in a tight feedback whereby you pay Joe to do a contract and Joe earns just enough money to pay his salary but not to support the infrastructure of the institute. We do try to cost as fully as possible.

444. Whether the money comes to the contractor or to the institute, there is an inflow of money into this country, is there not?
(*Professor Krebs*) It is an inflow of money into this country into the institutes, yes.

445. It is an inward investment, is it not?
(*Professor Krebs*) Yes.

446. Do you have figures for it?
(*Professor Krebs*) I can send you some figures, yes.

Chairman

447. Again, that would be very helpful. We need to support our case with statistics as far as possible. I take it now from what you have said that under your new mission you are fully prepared to do work in the field of environmental science even if the outputs are only appropriable overseas. That is clearly a part of your policy. If industrial support is a positive indicator of success, does it matter where the industry in question is located?

[Chairman *contd.*]

(*Professor Krebs*) I have thought quite a bit about the answer to that question. It is a difficult one. First of all, I think that there will be pressure on me to look hard at my international activities and ask the question of whether I should be spending a higher proportion of my budget on local problems, such as land use or pollution in the United Kingdom. As I said, I feel that many environmental problems are transnational. We have to be very careful about moving away from the transnational commitment. We do not want to lose the benefits that we have discussed. As to whether it matters if a user community is an overseas user community, it is not possible to give a simple answer. I can think of cases where, by doing underpinning science or contract work support in overseas industry we will enhance global wealth, and therefore indirectly enhance United Kingdom wealth, by helping third world economies to develop. Of course in many cases our users are UK government departments and, insofar as they have an interest in overseas industry, we follow their interest by doing contract work for them. There are a number of cases where we help to develop industries overseas—for example, tropical forestry, through our basic understanding of forest ecosystems—which are not competing in any sense with UK industry. They are creating inward investment through our contract consultancy work and are not detrimental to the United Kingdom. There may be other areas where the difficult question would be: if we had an opportunity to help a direct competitor in another country, would we rather help a UK industry? That situation has not arisen for us but I would have to wrestle with it if I had to make that choice.

448. If there are no further questions from the committee, would you like to add anything to what you have already said?

(*Professor Krebs*) I do not want to hold up the committee, but briefly I should like to say that one area that one could see as an inward investment in which we are involved, and many of the other groups to which you will be speaking may be involved, is training. It is an inward investment in the direct sense in that one is getting money from fees or from people coming and living in the United Kingdom; but in the longer term it also has an inward investment consequence in that training is one of our ways of building up a worldwide network of contacts. Although we are a research organisation, obviously we fund training in universities, and our institutes have training elements. I see that as an important export, if you like.

Lord Nelson of Stafford

449. Do you mean specific training courses or do you mean participation in your programmes as an element of training?

(*Professor Krebs*) I mean both. We run specific courses. For example, the Institute of Hydrology recently ran a course in Nairobi training local scientists in hydrological modelling; BGS runs courses overseas, for which they charge, or they run courses in the United Kingdom. Those are the direct by courses. But, more generally, people come and participate in our community, bringing knowledge and also gaining knowledge from us and therefore being part of our large network of overseas contacts. So the answer is both.

Chairman

450. If it is not too much trouble, we should like to have some figures from you on your support of Master's degree courses, PhD studentships and post-doctoral students and any evidence that you have about established research workers from overseas who come and work in your institutes. Any information on those lines would be invaluable.

(*Professor Krebs*) Yes, we can certainly provide that.

Lord Perry of Walton] Perhaps I may add that it would be more useful still if you could differentiate between those who are in your own institutions and those who are in the universities. We do not want to double count.

Lord Nelson of Stafford

451. If I understood you correctly, your courses are rather more specific to a particular subject rather than academic. Is that right?

(*Professor Krebs*) I was referring to our institute activity. The institutes run vocational short courses of the kind that I have described. We also have an extensive programme of PhD training as well as vocational MSc training. But those are largely for UK students. But the fact that there is, say, an MSc in applied conservation at University College, London, partly funded by NERC, attracts overseas students who wish to get expertise. So that is an indirect knock-on effect of our investment.

Chairman] We are very grateful to you. Thank you very much. We look forward to receiving the helpful figures that you said you would send us.

WEDNESDAY 27 APRIL 1994

Present:

Nelson of Stafford, L.
Perry of Walton, L.
Porter of Luddenham, L.
Selborne, E.
Walton of Detchant, L. (Chairman)

Memorandum submitted by the BBSRC (formerly AFRC)

I am writing in response to your letter of 31 January seeking answers to three specific questions in advance of our formal response to your call for evidence. I should point out that our answers relate, as you asked, to the activies of AFRC. From 1 April a new Research Council, the Biotechnology and Biological Sciences Research Council, will bring together the science of the AFRC with areas of research previously under the responsibilities of the SERC, from whom you will no doubt have sought evidence separately. In the biochemical engineering field, which will be central to the activities of BBSRC, there is particular interest from international pharmaceutical and chemical industries in UK work in biomolecular design and modelling.

1. *In what sectors within your remit are you aware of particular international involvement in UK science?*

There is international interest across most of the AFRC remit. The new biotechnology industries are developing rapidly in most advanced research countries, and the agro-industrial and pharmaceutical industries from which they are in part emerging involve numerous multinational companies. However, we perceive particular international interest in UK science in the following areas:

- animal biotechnology, eg production of pharmaceutical proteins and novel methods of vaccine production using molecular and genetic techniques;
- animal health eg vaccines, diagnostic kits and reagents;
- plant biotechnology, eg maize breeding, designer oil crops, biomolecular design and modelling, biotransformations and carbohydrate research.

Research institutions are becoming more skilled at dealing with overseas contracts and issues such as IPR. While researchers might still prefer to deal with UK funding bodies, given the choice, we are not aware of widespread problems associated with overseas funding. The only general complaint concerns the very slow payment procedures of EC and some other bodies. This often obliges institutions to undertake expenditure and then wait some time for reimbursement, which can cause financial problems.

2. *What is the extent of international involvement by the AFRC itself?—whether by means of AFRC supporting work done overseas, AFRC institutes doing work for overseas interests, co-funding work in the UK, or other means? Please distinguish as far as you can between overseas interests of a commercial nature, those of a public-sector nature, and international collaborative programmes.*

AFRC does not subscribe to any large international research facilities overseas. The attached table (*not printed*) shows the involvement of AFRC institutes in various types of work funded by overseas organisations and in overseas activity funded within the UK during the last three years. A number of points are apparent from this:

- well over 50 per cent of international activity is funded by the EC. This is collaborative research, which may or may not involve companies in the UK or other EU states, but is aimed at developing precompetitive or generic technologies rather than company– or product-specific results. EC research funding is not intended to cover the full cost of research; most of the projects involved are 50 per cent funded by AFRC;
- many of the contracts from overseas non-commercial organisations are also co-funded research collaborations (NATO, ESF, WHO etc);
- work overseas funded by non-commercial agencies is mainly work in connection with overseas aid programmes, eg funded by ODA. It tends to be service or advisory work and in that sense represents the sale of UK research expertise rather than research collaboration.

We are unable to provide data equivalent to that in the table for the University sector.

3. *What is the position of intellectual property created through AFRC funding or in AFRC institutes? Is there any restriction against such intellectual property passing overseas?*

AFRC adopts a flexible approach to intellectual property (IP) arising from Science Budget-funded programmes in both institutes and universities. Responsibility for IP and its exploitation is delegated to these institutions. They may assign, or retain and licence, the IP on an exclusive or non-exclusive basis, or it may be assigned to agencies such as BTG to exploit on their behalf. But these arrangements will normally include

revenue sharing arrangements which reflect the institute/university contribution to the innovative process. There is no restriction against such intellectual property passing overseas but in such circumstances a revenue share becomes even more important.

I hope that this provides the information you require.

Tom Blundell

17 March 1994

Further memorandum by the BBSRC

The Biotechnology and Biological Sciences Research Council (BBSRC) was formed on 1 April 1994, incorporating the work of the former Agricultural and Food Research Council (AFRC) and the Biotechnology Directorate (BTD) and the Biological Sciences Committtee of the former Science and Engineering Research Council (SERC).

On 17 March 1994 AFRC wrote to the Committee responding to three specific questions. The information given in that reply should be considered as a supplement to this response.

1. *What is the extent, nature and variety of overseas investment in UK science? How does this compare with investment by UK interests in science overseas?*

There is overseas interest across the whole range of BBSRC research activity. Our earlier response identified particular highlights in the former AFRC area and to that list should be added biochemical engineering, biomolecular sciences (especially biomolecular design and modelling) and cell and molecular biology (and especially signal transduction, which might provide the basis of targets for drug discovery). We are unable to quantify the extent to which this interest is expressed in terms of overseas investment (other than for the former AFRC institutes, see table attached to our letter of 17 March 1994) as this will mostly be in the universities.

Investment currently takes one of three forms:-

(i) part-funding of basic or pre-competitive generic research programmes or training, mostly by the EC. Such programmes commonly involve European industry as well as research institutions;

(ii) funding for applied research programmes;

(iii) purchase of services such as analyses and consultancy studies;

(iv) money is available to individual research teams from pharmaceutical companies for strategic research programmes, in precompetitive areas. This allows foreign companies (especially from USA and Japan) to transfer knowledge which underpins their more applied programmes and to use senior British scientists as consultants.

In addition there is some contribution to future research obtained by the licensing of institutions' intellectual property.

BBSRC does not invest in science overseas to any significant extent, other than by contributing to the costs of UK scientists in international collaborations. Unlike some other research councils it has no subcriptions to international facilities overseas.

2. *What factors influence potential investment in deciding whether to come to the UK for science or to go elsewhere? (whether elsewhere in the EEC, or elsewhere in the world)*

The primary factor attracting overseas investment into UK science must be the quality of UK scientific research and its relevance to aspects of wealth creation, improvement in the quality of life and the needs of less developed countries. Considerable effort has been made by research councils and institutions to increase this relevance in recent years and the establishment of BBSRC is a further step towards this in the fields of biotechnology and biological sciences.

However, given the basic quality and relevance of UK research there are a number of additional factors which are important in attracting overseas interest. It is essential to promote awareness overseas of what UK institutions can offer. In recent years almost all universities and research institutes have developed liaison offices to promote international involvement in their research and training activites. BBSRC has links with counterpart agencies in other countries, to promote awareness of UK activity and collaboration in areas of mutual interest. BBSRC also provides guidance on UK activity in biotechnology and biological sciences to the British Council, Science Counsellors in UK embassies and others with a role to play in promoting awareness of UK research abroad.

Access by research institutions to funding to enable the establishment of collaborative links, particularly to undertake precompetitive research within an international collaborative context, is essential. Although BBSRC can provide small amounts of direct funding to UK researchers to explore such links, as do organisations such as the British Council and the Royal Society, the main route is via participation in

international research programmes such as the EC R&D Framework, COST, Eureka, NATO schemes etc, international agencies such as ESF and international aid programmes. Thus BBSRC, in common with the other research councils and with the coordination of the OST, puts much effort into both influencing the objectives and management of such international activities and to encouraging awareness within the UK of the opportunities which they offer.

There are cultural and communications difficulties inherent in collaboration overseas and particularly with industry. UK institutions have, in general, developed considerable professional expertise in international project management, and in handling potentially complex issues such as IPR. Evidence—for example the high rate of UK participation as a coordinator in EC projects—suggests that this professionalism, together with the attractions of English as a working language, make UK institutions attractive partners for overseas industry.

The lower cost of scientific salaries in the UK compared with other Western European countries may also be an incentive to industrial investment.

3. *What are the benefits to the parties concerned and the wider economy?*

The obvious benefit is that overseas investment in UK research provides funding which strengthens the research base and contributes to stability of employment for our scientists and technical staff. There are often follow-up benefits in terms of development of expertise and the fostering of further international contacts through networking. For example, a small contract from the EC COMETT programme to the John Innes Centre (JIC) to prepare a feasibility study on multimedia training in biotechnology ultimately led to the JIC becoming coordinator of the European Biotechnology Training Consortium, establishing JIC as an international training centre in this field.

4. *What is the level of expenditure by investors and are there costs to the hosts?*

Almost all research institutions now endeavour to recover at least full direct costs in research programmes and, in the case of industrial contracts and the provision of services, indirect costs and possibly a contribution to repay the earlier investment in developing marketable expertise. EC programmes pay only a proportion of costs and involve host institutes in expenditure which can sometimes be difficult to meet. Funding from aid agencies is often very slow to be paid, involving institutes in underwriting costs for long periods.

5. *What are the policy implications for the British government and British science?*

International involvement in British science is highly desirable provided that adequate provisions are made for the protection of IPR. The opportunity for students and postdoctoral workers to study and research in an international context is of considerable importance in the development of the future skills base in science and industry in the UK. We should take advantage of the attractiveness of the UK as a place to undertake research, in terms of quality of science, language and relatively low cost, and continue to encourage overseas investment.

21 April 1994

Examination of witnesses

DR B G JAMIESON, Deputy Chief Executive, PROFESSOR R B FLAVELL, Director, John Innes Centre, and MR S M LAWRIE, Head of Commercial Policy Group, Biotechnology and Biological Sciences Research Council (formerly AFRC), were called in and examined.

Chairman

452. Dr Jamieson, may I invite you to make an opening statement and as this is the first appearance of the BBSRC before the Committee kindly to introduce yourselves and your new council.

(*Dr Jamieson*) My Lord Chairman, thank you. First I should like to introduce ourselves and then say a few words about BBSRC. Professor Dick Flavell is the Director of the John Innes Centre, which is one of the independent institutes supported by the BBSRC. It is a world leader in plant and microbial sciences.

453. I believe that you came and gave evidence to the Committee on biotechnology, did you not, Professor Flavell?

(*Professor Flavell*) My Lord Chairman, yes, indeed.

(*Dr Jamieson*) Mr Scott Lawrie is currently the Head of the Commercial Affairs Unit in the BBSRC office in Swindon. My name is Brian Jamieson and I am the Deputy Chief Executive of the BBSRC, a title that is also new. The Biotechnology and Biological Sciences Research Council, the BBSRC, supports research and training relating to the understanding and exploitation of biological systems. That is our remit in its broadest terms. Like the other new research councils we are a mission oriented research council and our ultimate mission is to aid the creation of wealth and to improve the quality of life. We are committed to meet the needs of users in Government, and that is particularly in departments like the Ministry of Agriculture, the Department of the Environment, the Department of Trade and Industry, but others also, through undertaking research on their behalf on a repayment basis and by other means, and of course industry. The principal industries that we underpin are agriculture and food, carried forward from the AFRC responsibility, the chemical industry, the pharmaceutical industry and other biologically based industries. We have this year a grant from the science budget of £172 million and that enables us to support about 7,500 scientists, technicians and students either directly or indirectly in universities and in research institutes. By competitive processes of peer review, merit review and assessment, the funds or grants that we allocate go almost in equal portions to the universities and to the institutes, almost a 50/50 split. Although we are able to describe in general terms the international investment situation in the universities it is only in the institutes that we support that we are able to provide the quantitative data that we have appended to our written submission. Although the institutes are largely independent and enjoy devolved managerial responsibilities and authority we do have the responsibility of accounting for the public funds in the institutes. That accountability extends right through to the Public Accounts Committee of parliament. In the BBSRC we take our industrial links and responsibilities for technology interaction, technology transfer, very seriously indeed. We are trying to build on the achievements of the AFRC and the Science and Engineering Research Council in those areas. Within our structure we are setting up three directorates, one for agricultural systems, one for food and one for the chemical and pharmaceutical industries. These will provide foci for developing and promoting and implementing research programmes which are of direct relevance to those industries. There will be representatives of those industries on the committees that oversee the programmes of those directorates. My Lord Chairman, I think that that is all that I want to say by way of introduction. As we proceed through the questions I am sure that we will be able to give you a broader appreciation of what we hope to achieve with the new research council which is a rather exciting opportunity in scientific areas of enormous potential. We are underpinning industries—agriculture, food, chemicals and pharmaceuticals—which are contributing to the national economy and which do depend on science and technology.

454. How many institutes do you have? They are presumably all directly funded and administered by your council?

(*Dr Jamieson*) We support eight institutes, my Lord Chairman. Five of those institutes like that of Professor Flavell, the John Innes Centre, are independent institutes grant aided by the council. Over the years—and Lord Selborne when he was Chairman of the AFRC gave a strong lead in this direction—we have been encouraging the institutes to diversify their funding base. We have devolved managerial responsibility to the institutes within the broad rules and regulations which are compatible with our accounting officer's responsibilities to parliament. The present position is that of these institutes only three depend on the BBSRC's science budget funding for more than 50 per cent of the total funds. So they have diversified quite successfully. We have encouraged industrial linkages as well as links with the European Commission in respect of both funding and exploitation routes.

455. I was on the Medical Research Council, or involved in it, for 12 years and came off in 1978, a long time ago. They of course have a couple of institutes but they also have units and award programme grants and project grants. You obviously award project grants. Do you have any units apart from the institutes, in universities or in association with them?

(*Dr Jamieson*) We do indeed have a range of structures with the institutes at one end of the spectrum, my Lord Chairman. We support four interdisciplinary research centres, the IRCs, which are almost the equivalent of units in universities; we support four units more in line with the Medical Research Council units which are subject to five-yearly review, we have programme grants and we certainly have three-year project grants. The intention is for the new council to develop those research structures as appropriate to its mission. This may involve expanding in some areas and contracting in others. We will maintain and review the balance of the support structures.

Lord Perry of Walton

456. What proportion of the total expenditure goes to the institutes?

(*Dr Jamieson*) My Lord Chairman, about half of the BBSRC's research expenditure goes to the institutes.

Lord Porter of Luddenham

457. That is the seven institutes not including the interdisciplinary research centre in universities?

(*Dr Jamieson*) Only the eight research institutes. The interdisciplinary research centres are classified under our university research expenditure.

Lord Perry of Walton

458. They are earning half as much again as the grant from Government if they are earning 50 per cent from outside sources?

(*Dr Jamieson*) Yes, they are, my Lord Chairman, and perhaps Professor Flavell would like to illustrate that by describing the position in his own institute.

(*Professor Flavell*) My Lord Chairman, in the last few years we have taken up the cudgel of competing as effectively as we can for all sorts of relevant resources. Many are internationally based from aid agencies in the agricultural sectors, from industries, it is a very broad church. My institute, for example, has sponsorship from 53 different organisations world wide so when you total those 53 you get a substantial part of our total operating budget.

Chairman

459. That, of course, is partly contractual work, is it not, work that you do on contract for people overseas, or is it simply grant aided research?

(*Professor Flavell*) There is very little that is tough, tight contract, my Lord Chairman. I should put much of it into the category of grant aided research and there is a very large other kind of income which is not classified on paper as pounds or dollars because it is people who are supported by their home countries or other institutions who come to get a training period. They are of course contributing to our intellectual base and our output and that is a very substantial quantity of the investment.

Lord Perry of Walton

460. Is there any way that we can quantify it, Professor Flavell?

(*Professor Flavell*) We do it internally, my Lord Chairman. In our internal accounts obviously we have to know what they cost us and we note their salary. I recall I think that we estimate something like 25 per cent of our income which could be classified in this hidden category of money coming in along with people even though we do not handle their salary through our organisation.

Chairman

461. Professor Flavell, it seems to me in the table you have given us that you have given the broad range of income coming from the EC, overseas commercial, overseas non-commercial sources and so on. It might be very helpful to get a picture from a single institute such as yours of the level of funding which comes from a variety of sources, from overseas and the United Kingdom, such as that to which you have referred?

(*Professor Flavell*) Regarding our sums last year, my Lord Chairman, from the BBSRC our income was something close to £8 million and I calculated our real income to be about £15.9 income, but we could break that down into these categories for you and provide it for you.

462. Thank you, that would be most helpful.

(*Dr Jamieson*) We should be pleased to do that, my Lord Chairman, because we did feel rather constrained by the format of the question. There is a sense in which the intellectual inward investment is more important than the financial inward investment. We can count heads but what we cannot measure is the added value that these people are contributing to the institute and to the economy.

Lord Perry of Walton

463. It is extremely difficult in the university sector to disentangle overseas people who are supported from their own country from those who are supported by grants that emanate from this country. I imagine that it is easier in a research council?

(*Dr Jamieson*) I think that it is easier, my Lord Chairman, but the figures which we have promised you will probably contain an element of that imprecision, I fear.

Lord Nelson of Stafford

464. Under your new terms of reference and your new title

where do you divide the line between agriculture and medical? I particularly had in mind such problems as "mad cow disease", for instance.

(*Dr Jamieson*) That is an interesting question, my Lord Chairman. We do have to have close working relationships with the Medical Research Council, at the very top—at the chief executive and senior management level—at the research scientist level and in between. There are a number of areas of interface: I think of immunology and genome analysis, where the BBSRC is particularly interested in plants. The BBSRC is the only research council now promoting fundamental plant science. On the other hand, on animal genomes we have to work closely with the Medical Research Council and ensure complementarity and collaboration and no duplication.

465. Including their medical properties?

(*Dr Jamieson*) Indeed, my Lord Chairman, and of course there are model systems and genome analyses which are relevant to both medical research and agricultural research and other experimentation. Human nutrition is another area where we have to have a very effective interface with the Medical Research Council and, indeed, with the Ministry of Agriculture, Food and Fisheries. We have formal structures to review those interfacial areas to consider at strategic level the opportunities for joint programmes. These we can launch using our own resources or use as a basis for seeking additional funds from the science budget. The interface with the MRC is an important one and it is one that we do

[Lord Nelson of Stafford *contd.*]

keep under review. We are very conscious that the two councils must where appropriate work together.

466. If one takes the case of "mad cow disease" and the dispute with Germany, who takes the lead in trying to clarify that very important issue?

(*Dr Jamieson*) The AFRC and the Ministry of Agriculture have a regulatory responsibility. They carry out quite a lot of the epidemiological work and the long term experiments on maternal transmission. The MRC obviously has the lead, the sole responsibility for the human pathology of CJD, those sort of issues. The BBSRC's role, which is pursued at our Institute of Animal Health, is to look at the nature of the infective agent, its structure, its infectivity. In those areas we are of course co-ordinated in our activities by the Tyrell Committee. We are in membership and obviously provide papers and offer support to the Tyrrell Committee, jointly with the Ministry of Agriculture, the Medical Research Council, and the Department of Health as necessary.

Chairman

467. And the joint committee chaired by David Tyrrell of the Medical Research Council and the Ministry and yourself is still functioning very effectively, is it not?

(*Dr Jamieson*) I believe so, my Lord Chairman.

Lord Nelson of Stafford

468. And that is a satisfactory way of dealing with the problem which has three facets here in order to come out with a coherent reply to the German case which they are making, is it?

(*Dr Jamieson*) I believe that is an adequate structure to oversee the various efforts, but the structure itself will not guarantee an early identification of the root of the problem, nor will it ensure that the incidence of BSE declines any more rapidly than it is currently doing. That is all as a result of what happened in the past.

Lord Porter of Luddenham

469. I wonder whether I might invite Dr Jamieson to say a little more about the area of plant biotechnology?

(*Dr Jamieson*) Yes, my Lord Chairman.

470. When you were asked what are the areas of particular international involvement you gave this as your third one in your reply?

(*Dr Jamieson*) Yes, my Lord Chairman.

471. We hear a terrific amount in these committees about pharmaceutical and chemical industries and the vastness of them and their importance to the economy, and this is quite true. My question really is, can you say a little about plant biotechnology, its size? How important is it in fact, especially the international involvement in pounds to the economy? You say that the main areas are maize breeding, designer oil crops, which I should be very interested to hear another word about, biomolecular design and modelling, biotransformations and carbohydrate research. Can you say a word about the importance of this? We hear very little about plant biotechnology.

(*Dr Jamieson*) Yes, indeed, my Lord Chairman, and then I will ask Professor Flavell to answer the question substantially because a lot of the work that we describe is in his institute. Professor Flavell is currently President of the International Society of Plant Molecular Biology, which has its annual meeting next month in Amsterdam.

(*Professor Flavell*) Your Lordship asked about a series of points. Let me try to dissect them. You will probably find me avoiding giving you a figure about the value, but I am sure that there are many market surveys that we can use to provide that figure. I see that the biotechnology revolution has become as attractive to plant scientists as any other partly because of the technology driven but I also think because of the means of inserting new genes into plants to change them and to get stably inherited plant out of it it has created in many minds the opportunities that go far beyond our conventional use of plants in agriculture and horticulture. Having captured people's imagination it started to drive the business community and I think that we have seen in the last ten years a major shift by the agri-chemical companies into this area. We have seen ICI and Zeneca buying seed companies. We have seen Montsanto and DuPont in the United States making huge shifts in their investment into plant biotechnology because they see that this is a different way for them to be a major market player in the agricultural scene. The opportunities for diversifying the functions of crops are very much on people's minds, but of course we have yet to see the reality of those products. Oilseed rape grows successfully in northern Europe and many have seen the opportunity to change the oil content of it, particularly in its quality so that it serves a different industrial sector. Some innovative research initially in the United States has indeed demonstrated that to be the case. You can get a large proportion of the oil accumulating in those seeds to have a different structure and therefore a different function in the industrial sector so now it is a target that is supported by UK industries and MAFF in our institute and on a competitive programme world wide to diversity these oils.

472. May I just check, is this for mechanical and fuel or for a vegetable product?

(*Professor Flavell*) It is for a vegetable oil, as a raw material for making plastics, and a whole range of those sorts of polymers. It is different sorts of oils that would be equivalent to palm oil on the one hand or auric acid. Lubricating oils are very much in vogue, but I think that until the economics that you know about change for fuel oil it is not going to be used for that on any quantity at all.

473. Are there some countries that are interested in us from this point of view? I believe that Austria is using it as a cheap oil, is it not?

(*Professor Flavell*) Yes, my Lord Chairman, a small amount, but I think that the economics are still the overriding factor and I do not see a major shift in that for us. There is considerable interest from numerous countries in our oilseed rape modification

[Lord Porter of Luddenham *contd.*]

programmes because of substitutions. That is what it is really all about, substitutions.

474. Genetic?

(*Professor Flavell*) It is substitution of using a crop oil for some kind of oil that is made by chemical modification of fossil fuels.

(*Dr Jamieson*) Technological substitution and the enormous costs of investment in new plant are major obstacles to the adoption of some of these technologies.

475. To be clear, my Lord Chairman, you are not saying that they are interested in our genetic modifications?

(*Professor Flavell*) Yes, my Lord Chairman, because that is the route through which one has an opportunity to test in the market place as to whether these products have a market viability.

Earl of Selborne

476. Perhaps I may move on to one specific area that has been of interest to the Committee and that is prevalence in this country of the animal rights lobby. Now this has a direct bearing on the culture in which the BBSRC operates, particularly in its animal research. It is clear that you have been able to attract international grant aid because of the quality of the science, because of the climate in which science is conducted in this country, but in this one respect you must be clearly at a disadvantage in the sense that there are apparently risks in this country which others do not face. Would you like to comment on that and would you like to say whether there is anything that you feel Government can do to hold the situation or to redress what could be a commercial disadvantage?

(*Dr Jamieson*) My Lord Chairman, it is certainly an apparent difficulty; I am not sure that it is a real one. We are of course concerned about the activities of animal rights activitists and our institutes have been the subject of attacks and threats. This has led us to invest quite considerably in security measures at those institutes most involved in animal experimentation at a cost which has been at the expense of scientific research. However, we have no real evidence that this has deterred the overseas companies placing contracts. It does seem to us that it is the quality of science, the project management, value for money considerations, which seems to predominate in their thinking. I cite, for example, a major contract which the Institute of Animal Health at Compton has from InterVet of some half a million pounds, I think, for further work on the coccidiosis vaccine. I hesitate to suggest that there is anything that Government could do to minimise or remove this threat. It is a problem that society has to bear and live with. Any strengthening of measures might be counterproductive and might draw the attention of the activitists to the research laboratories. We believe that we have contained the problem. We are vigilant. We are spending money on the necessary security and we do not believe that this is putting us at a competitive disadvantage.

477. Perhaps I may move on to another aspect of regulation which concerns Professor Flavell's institute more possibly, that is, biotechnology regulations. In a previous report this Committee drew attention to the fact that there appears to be an imbalance between the degree of regulation in America and that in Europe and again is this in any way inhibiting inward investment in your research institutes in respect of the degree of competition in America?

(*Professor Flavell*) My Lord Chairman, I do not think that it is, and there are perhaps two or three reasons for that. One I suspect is the effect of the report from this group previously. There is no doubt that the efficiency and streamlining with which cases are now handled in the United Kingdom have improved, whatever that word means, very considerably and it is very interesting that this week the committee was considering a proposal put in for field release for commercialisation of oilseed rape for a company based in Belgium.

478. Which committee are you talking about?

(*Professor Flavell*) The House of Lords Science and Technology Committee.

479. But you said that a committee was considering a proposal. Which committee?

(*Dr Jamieson*) I am sorry, my Lord. The regulatory committee.

Chairman

480. You are talking about the regulatory committee that has been looking at an application?

(*Professor Flavell*) I am sorry, yes, my Lord Chairman, the advisory committee for the release of genetically modified organisms this week was considering the specific proposal coming from a Belgian company and I am quite confident that the reason that they chose the United Kingdom committee and system to evaluate this release first is because in the last nine months there has been a substantial in the ease with which one can deal with and operate through the United Kingdom systems. I think therefore that is the first point. Things are not the same as they were a year ago. I do not think that we have evidence that that has held up investment in the past because we are only just coming into the period where the efficiency of the release systems comes into the business planning of companies. If we had stayed in an awkward period for another three or four years and the science progresses to where the external testing is a bigger part of the research activity then I think we should have come up against these difficulties.

Lord Nelson of Stafford

481. Why is it easier now than it was 12 months ago?

(*Professor Flavell*) I think because the regulatory committees have chosen a structure which enables them to pool knowledge and to streamline the decision making process instead of taking every situation separately again and again and again every time that they come up against a particular proposal to release.

Chairman

482. That was one of the recommendations of our previous report, and I am very glad to hear that it appears to have had an influence upon the machinery. From what you say I think that it is clear that you regard your science community as invisible exporters and you have identified several areas in which UK science and international interest are strong, namely biochemical engineering, animal and plant biotechnology and animal health, for example. Could you perhaps give us any other specific examples in each of these areas where foreign money is coming into UK science?

(*Dr Jamieson*) My Lord Chairman, in biochemical engineering the main strengths in the BBSRC community are at two IRCs, one at University College, London, and one at Birmingham University. There has been considerable foreign investment in both from the EC and from commercial companies. They are in the general areas of bio-reactor design and performance and fermentation technology. Mr Lawrie could perhaps elaborate on the success that University College, London, have had in this area.

(*Mr Lawrie*) My Lord Chairman, a Japanese company, Eisai, has invested £20 million in University College, London, primarily in the area of neurological science, but a factor in determining the recipient in this investment was the expertise at the Biochemical Engineering IRC to scale up the work. A substantial proportion of this funding will be devoted to that aspect, something in the region of £6 million to £8 million.

483. And at the Birmingham IRC what is the main emphasis?

(*Mr Lawrie*) I can give you examples of a couple of contracts there, my Lord Chairman. Ciba Geigy are funding a project in bio-reactor fluid dynamics and another project in aqueous two phase partition at the Biochemical Engineering Centre at Birmingham.

484. Thank you, those are some good examples, and you believe that the research institutions with which you are concerned are becoming more skilled at dealing with overseas contracts. Could you comment on what special skills are called for? You say that the EC—now the EU, I suppose—is slow to pay and that some other bodies are slow to pay for these research contracts. Can you give us some examples of that?

(*Dr Jamieson*) My Lord Chairman, perhaps I may say a few words on that and Mr Lawrie again could fill out the details. The AFRC, and the SERC before it, certainly created a climate in institutions that we should be seeking funds from overseas from industry generally. This led the AFRC and BBSRC institutes with which we are most familiar to review their procedures and their attitudes. Many of them have appointed commercial officers, people with experience of the management of intellectual property, experience of commerce. Both experience and success breed success. That is the climate we have created. Mr Lawrie could perhaps take that a little further.

(*Mr Lawrie*) My Lord Chairman, I think that it would be more correct to say that the institutes supported by the BBSRC are becoming more expert at dealing with contracts, technology transfer, exploitation matters, in general and not just with overseas contracts. As Dr Jamieson has said, the reason is that commercial units have been established progressively at our institutes over the years and the commercial officers have become experienced in such matters. I should say that the essential attributes they need to have are good negotiating skills, an understanding of the market concerned, an understanding of the legal aspects of agreements, and in particular knowing when to call in professional legal or patent advice and also how to deal with intellectual property which is always a major problem or likely to be a major problem in agreements. With intellectual property they are well aware of the fact that in many cases, particularly in dealing with companies abroad, it is essential to limit a licence to specific fields of use, to include non-performance clauses and to ensure in negotiating revenue sharing agreements that the full cost of underpinning research is recognised in the arrangements.

485. And the slow payers?

(*Mr Lawrie*) Examples of other bodies which are slow to pay are the World Bank, the European Bank for Reconstruction and Development, the European Development Fund and aid organisations in general. I think this is probably due to the fact that they tend to be large and fairly bureaucratic organisations and also albeit to a lesser extent that they do not have any requirement for annuality in the same way as the recipients of the funds in the United Kingdom have and therefore do not conform to that requirement.

486. When we met the Committee of Vice Chancellors and Principals last week we had some confirmation of evidence that we had had previously to the effect that a number of universities, for example, are becoming much more skilled at developing formal structures with intellectual property rights. Some have even established small companies to process this kind of thing. It is not out of the question that the CVCP may try to disseminate a code of practice suggesting the kind of formulae arrangements that might be employed. Now of course you rightly say that when IPR is licensed overseas, revenue sharing with the investor institution becomes particularly important. Are you giving advice to your institutes and others about this whole issue at the moment or are you leaving it to them to negotiate individually?

(*Dr Jamieson*) My Lord Chairman, it is a bit of both. We have in Swindon Mr Lawrie's unit which certainly provides advice and help with individual cases, but our general philosophy is to encourage institutes to stand on their own two feet in those matters and in many other matters. We have provided a framework and we have recommended that they do set up commercial offices of some appropriate shape and size. Professor Flavell can tell us what they have done at the John Innes Centre if you wish. We have provided guidelines, we have provided a steer, we have provided central advice and we do monitor the position, so we are able, for example, to provide you with the information we sent in a few weeks ago. That is the role of the centre at Swindon, leaving it very much to local initiative to develop along the pathways appropriate to the mission, to the culture, the scientific opportunities and the commercial opportunities which avail

[Chairman *contd.*]

themselves to particular institutes. Those do vary from institute to institute.

487. If we may look again at the same issue in a different light, it has been said to us from many quarters that the exploitation of British inventions has been rather poorly handled in this country and that there are too many occasions when very bright ideas have resulted in something which could have a major commercial application and that perhaps it has been initially exploited in the United Kingdom but then much of the further development has gone overseas. Suggestions have been made to the effect that British companies, for example, tend to look at short termism perhaps in the interests of their shareholders whereas some overseas companies are prepared to invest in UK science for long term returns. Is that a fair criticism? Do you have any evidence to support that view?

(*Dr Jamieson*) My Lord Chairman, I think that there is some evidence, but it is largely anecdotal. The BBSRC institutes, as is evident from the statistics that we have supplied, are relatively small players in the national and international scene and I should not wish to extrapolate from our own experience, but there is anecdotal evidence to support those points. However, I think that I must emphasise the council's position is certainly to hope that British companies will come forward to exploit inventions, recognising particularly in the chemicals and pharmaceuticals that we are more likely looking at a multinational company, one which has been unplugged, and the capacity to do the further investment. Our prime considerations are that the discovery should be exploited and that there should be commercialisation, to quote our mission "to increase the quality of life and to increase the creation of wealth". The markets for many of the discoveries in our laboratories are international, so we are quite comfortable in exploiting through international companies. We adopt what Professor Flavell calls a "win win" situation. What we do is try to negotiate a deal that does not slow or stop exploitation because we have been too greedy, but which is also fair to the institutes and fair to the UK taxpayer who has stood behind the initial investment.

488. You mentioned the liaison that you have established very properly at the margins of your fields of interest with the Medical Research Council and with other research councils. Do you have any formal liaison machinery with industry such as the Bio-Industry Association? Is it a formal and regular liaison?

(*Dr Jamieson*) Yes, my Lord Chairman, this is an area which the new council is having rapidly to develop, building on the inheritance from the AFRC and the SERC. More needs to be done to breathe life into the technology interaction part of our remit. We have formal and informal meetings with the Bio-Industries Association, the Chemical Industries Association, the National Farmers' Union and the Food and Drink Federation, to name the principal trade associations, if I may so describe the National Farmers' Union. The deputy president of the National Farmers' Union, Ben Gill, is a member of our council. He will also be a member of our Technology Interaction Board and he will be chairman of the agricultural systems directorate within the council structure. We also have on the council Dr Keith Humphreys of Rhone-Poulenc who is closely associated with the Chemical Industries Association. We have started closer working and through formal and informal structures. The formal structures will probably take the form of six-monthly review meetings with such bodies.

Lord Perry of Walton] Are there any steps that you think the various authorities in this country, Government or otherwise, could take to improve the level of overseas investment in the British science base?

489. In other words, what would you like us to recommend?

(*Dr Jamieson*) This does not answer the question, my Lord Chairman, but I will point out that the Biotechnology and Biological Sciences Research Council perhaps puts higher premium on the intellectual investment than on the financial investment. We are relatively modest players as far as financial investment is concerned. Our science is international. Ninety five per cent of the fundamental strategic science activity relating to ours is done overseas and we have to network, we have to collaborate and we have to see that our science base is enriched by the flow of people in and people out. We have no direct experience of the major financial investments such as the Yamanouchi research institute as yet, so it is rather difficult for us to speak with authority on what might be done to facilitate that sort of investment assuming that it is indeed government policy to do that, and I believe that it is, my Lord Chairman. I am not sure whether my colleagues have any inspired thoughts.

(*Professor Flavell*) My Lord Chairman, I think stating that message very clearly might be new to many. You have heard how in just a relatively few years there has been quite a shift in the scientific community to become aware of the linkages with industry, and this is very much a feature of the Biotechnology and Biological Sciences Research Council. I think we are still feeling that linkage with UK industry is number one and perhaps the scientific community does not vigorously try with other companies because of the sense of, "Well, is this the right thing to do?". I think if you say that message very clearly then the scientific community will get to work and attract more of the investment on the basis of the quality that I believe is there now that we have the skills in generating the right intellectual property and licensing agreements that will ensure that there is a revenue flow back to the United Kingdom. With that in place it seems to me that it is a policy that is sensible and straightforward, but I am not sure that we have ever heard it stated as vigorously or we have never listened to hear it stated as vigorously as perhaps it should be.

(*Dr Jamieson*) If I may come back on that, my Lord Chairman, I think we should be disappointed if there was any sense in your recommendations that we should be little Englanders and insular in any way. You might recognise the international dimension and dynamic of our science; recognise the added value that networking and the movement of scientists and ideas to and from these shores contributes; trust

[Chairman *contd.*]

us through the mechanisms that we have described to be responsible in the exploitation of technology, and certainly to give British companies a fair crack of the whip, but not to discourage us from looking overseas and to trust us to spot any Trojan horses that might appear on the horizon.

490. At the level of peer review, given that industrial support is a positive indicator, does it matter where the industry in question is located?

(*Dr Jamieson*) My Lord Chairman, I think the short answer is that it does not. If exploitation, improving the creation of wealth and improving the quality of life nationally and internationally are our objectives, I certainly can give the assurance that we will increase our links with British industry. We will give British industry through its membership of our Council and its planning committees every opportunity to guide the strategic direction of our research and that, I think, will be an enormous benefit to British industry. British industry will have every opportunity to exploit the fruits of that research but we must play on an international stage.

Lord Nelson of Stafford

491. Are you happy with their response to that initiative?

(*Dr Jamieson*) Yes, we are encouraged by the response that industry has given even before the new research councils were created, but now that we have taken the Government's message, the wealth creation message of the White Paper, directly to the industries we underpin we are very encouraged indeed. The two gentlemen I mentioned, Ben Gill of the National Farmers' Union and Dr Keith Humphreys of Rhone-Poulenc, together with Dr Ed Dart of Zeneca and Dr Tom Little of Unilever, are members of our Council. They are really senior industrial directors managers. They have demonstrated already that they are very keen to play a full part in the planning process and the other activities of the council.

492. And the exploitation process?

(*Dr Jamieson*) And the exploitation, indeed.

Earl of Selborne

493. My Lord Chairman, I should like to move back to Government's role in promoting inward investment in research particularly so far as it concerns the research councils. Professor Krebs when giving evidence to us last week alerted us to a specific concern that the NERC have, that the scrutiny exercise which is being conducted at the moment in government research establishments is including research institutes of the research councils and he thought that this was in danger of having a direct effect on the competence of these research institutes to attract inward investment. Would you like to comment on that?

(*Dr Jamieson*) Yes, indeed, my Lord Chairman. We should share Professor Krebs' concern about the inclusion of the research council institutes in this scrutiny of government research objectives. Their objectives are different from those of the government research establishments. Some of the problems which have been perceived in government research establishments do not apply to research council institutes, certainly not to the BBSRC institutes. The sort of recommendations that seem to be emerging from the scrutiny would move research council institutes from the strategic responsibility for planning which research councils have, almost putting them into a research market. While that may be appropriate for government research establishments who are much more commercial in the range of their activities, providing services and advice, it does not apply to research council institutes notwithstanding the commercial funding which we have described and of which we are proud. The research council institutes are really an important part of the science base. The provision of some of these important facilities cannot be left to the market in my view. I think of the containment facilities for exotic virus diseases at Pirbright. That is a unique national facility, a very essential one. I do not believe we can leave it to the market. The market either would provide no such facilities or perhaps would duplicate the facilities in an unhelpful way. You do need a research council, I strongly believe, my Lord Chairman, to plan the provision of those facilities and to maintain them at a strategic level, leaving all the day to day operations and the scale of the operations very much to the institute, reflecting the quality of its science and its ability to attract funding from its parent research council and all the other sources that we have indicated. If the research council institutes were fragmented and left either to stand or to fall on their own two feet or in groupings with government research establishments, I do believe that their ability to operate in the international platform we have been discussing could be at risk.

Chairman

494. Yes, and surely it carries the very considerable danger of destroying the long cherished principle of the kind of arm's length relationship between Government on the one hand and the research councils on the other where the research councils after all have enjoyed the principle of self-regulation of their activities; it is potentially a very disturbing trend, and I think that it is clear that you share that view?

(*Dr Jamieson*) Yes, my Lord Chairman, we share those worries.

(*Professor Flavell*) My Lord Chairman, may I perhaps interrupt just to say that in my experience we have clear examples that the reason why companies especially overseas ones and foundations like the Rockefeller Foundation come to us and invest reasonable sums of money with us is because they recognise that we have a track record of stability in producing high quality results that goes back over many periods of years. I think the formula for sustaining that and therefore attracting potential investors could well be seriously undermined by some of the ideas that are implicit in the scrutiny exercise. I think therefore from our experience of specific examples that we are concerned, yes.

495. Thank you. That is very clear because it is also I think evident that some overseas institutions are happier to invest in scientifically controlled bodies rather than direct government controlled bodies even

[Chairman *contd.*]

though those government controlled bodies may be concerned with research. May I then follow that point up because we have had evidence from other sources to suggest that, for instance, Japan used to invest heavily in US research institutes of various kinds but there has been a shift of Japanese overseas investment much more toward the United Kingdom for a variety of scientific, cultural and social reasons. Apparently 40 per cent of overseas investment from Japan is now coming to the United Kingdom, and 40 per cent of US investment is also coming to the United Kingdom. It has been suggested to us that we should look much more carefully at other countries, such as those in the Pacific rim, emerging countries such as South Korea, Taiwan, Singapore, Malaysia and so on. Is there any evidence to suggest that your institutes are looking towards those sources?

(*Dr Jamieson*) My Lord Chairman, we certainly are aware of the sort of trend that you describe, aware of the enormous rate of increase in GDP in the Pacific rim countries that you mentioned, the increase in the levels of education, the standards of education and improvements in the skill base. The extent to which our institutes should specifically target that area I think is really a matter for the institutes and their judgment as to just how much of their resource they can devote to that sort of activity. I am not sure whether Professor Flavell can add to that.

(*Professor Flavell*) My Lord Chairman, I think that it is very early days. I have not seen a shift that is commensurate with what you describe at these levels of 40 per cent in the plant science areas. We are becoming aware of the very considerable investment being made in our sector of science in those communities so I think we have seen the challenge that we have to learn about it and sustain these dialogues, but I do not believe that that has yet been converted into our seeking linkages with the industries of Japan and Malaysia and South Korea.

496. You have I think contract earnings from overseas interests, not including the EU, of about £4.7 million since 1991 and we should like to have some idea of the kind of projects involved, the overseas countries from which the investment comes and what proportion this represents of the income of the institutes. If you could come back to us with an answer on that one we should be very grateful.

(*Dr Jamieson*) My Lord Chairman, we will certainly do that. Would you like Mr Lawrie to take just two minutes to précis the information which we shall certainly send in full?

497. Yes, thank you.

(*Mr Lawrie*) My Lord Chairman, there is a wide spectrum of projects involved. They vary from fairly substantial three-year projects worth between £300,000 and £500,000 right down to short term projects of three months of a few thousand pounds and even consultancies of a few weeks duration. So there is a very big range of projects included in that figure. The overseas countries which are our major customers are, in order, the United States of America, then France and then other western European countries, then possibly Japan. The question also asks, "Why does the work come to UK scientists, and to you?". The answer to that very briefly, is that it comes to us because of our excellent scientific capability, because we provide value for money, as Dr Jamieson mentioned, because I believe we have a good record of delivery, and these factors are important. The £4.7 million quoted since 1991 over three years represents on a per annum basis about 1.5 per cent of the budgets of the institutes concerned. In terms of AFRC/BBSRC as a whole it is probably just under 1 per cent.

498. Thank you, that is very helpful.

(*Dr Jamieson*) Thank you, my Lord Chairman. We will write to you on the two matters.

WEDNESDAY 25 MAY 1994
in Edinburgh

Present:

Butterfield, L.
Nathan, L.
Perry of Walton, L.
Selborne, E. (in the Chair)

Note and slides provided by Dr Martin Fransman

The Institute for Japanese-European Technology Studies was launched in April 1989 at a reception hosted in his residence by the British Ambassador to Japan, Sir John Whitehead.

JETS is sponsored by the Japanese Ministry of International Trade and Industry, the British Department of Trade and Industry, the Lothian Regional Council, and a number of major companies including NEC and Fujitsu. JETS also has close links with the Japanese Science and Technology Agency and its National Institute of Science and Technology Policy and with the European Commission.

JETS has three major objectives:

— To do policy-oriented research on science, technology, industry, and business strategy in Japan and Europe.

— To promote co-operation between Japan and Europe by encouraging closer links between researchers in Japan and Europe.

— To develop a documentation centre on science, technology, industry, and business strategy in Japan and Europe.

In addition to its Internal Advisory Committee and its External Advisory Committee JETS has an Academic Advisory Committee whose members include many leading academics who are well-known internationally for their research in the area of science and technology policy.

For further information please write to—

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SLIDE 1

Japan's Two-Way Direct Overseas Investments with Leading Industrial Countries

	Japan's direct investments, by country (US$m)	*Foreign countries' direct investments in Japan (US$m)*	*Ratio of Japan's investment in host to host's investment in Japan*
UK	15,793	599	26:1
Germany	3,448	690	5:1
France	2,899	227	10:1
Netherlands	10,072	730	14:1
Switzerland	1,829	1,015	<2:1
USA	104,400	7,910	13:1
Total (all countries)	253,896	15,654	16:1

Source: The Anglo-Japanese Economic Institute (1991).

SLIDE 2

Overseas R&D Spending by Japanese Firms (US $ million)

	Total	*North America*	*Europe*
1983	60	38	N/A
1986	342	169	99
1989	468	308	100

Source: Cairncross (1992)

R&D Expenditure by Foreign Companies in Japan (US $ million)

	Total	*Manufacturing only*
1987	469	400
1988	627	507
1989	727	657
1990	842	791

Source: Cairncross (1992)

SLIDE 3

Japanese R&D and Design Activities in Europe in the 1990s

(The total number of independent facilities is in parentheses)

	1990	**1991**	**1992**	%[1]	%[2]
UK	24(9)	48(15)	73(19)	36(35)	26
Germany	14(6)	29(12)	39(14)	19(26)	36
France	11(4)	18(7)	30(9)	15(17)	30
Spain	11	15	23	11	0
Belgium	4(1)	8(2)	10(3)	5(5)	30
Italy	3(2)	8(1)	8(2)	4(4)	25
Netherlands	3	4	6(1)	3(2)	17
Sweden	1	1	3	2	0
Switzerland	1(1)	3(3)	3(3)	2(5)	100
Austria			2(1)	1(2)	50
Ireland	1	2(1)	2(1)	1(2)	50
Finland			1	0	0
Norway			1	0	0
Iceland			1	0	0
Total	73(23)	138(42)	203(54)	100(100)	

1. Total R&D and design facilities in that country as a percentage of the European total and, in brackets, the same figure for independent facilities in that country (1992).

2. Percentage of total R&D and design facilities in that country that are independent (1992).

Source: compiled from JETRO 8th Annual Survey (1992)

SLIDE 4

Major Japanese Research, Design and Development Centres in Europe

Source: JETS survey (Lauchlan, 1992) and JETRO 8th Annual Survey (1992) combined.

SLIDE 5

Research Personnel

Numbers of staff:	*1991*	*1995(est)*
Japanese:		
Technicians	3	5
Graduates	23	27
Postdoctoral	1	7
Total Japanese	27	39
Local:		
Technicians	20(17*)	38*
Graduates	38(30*)	52*
Postdoctoral	20(20*)	51*
Total Local	78(67*)	141*
Total Research Personnel	105(94*)	180*

Source: JETS survey

NB: This table relates to only seven of the 10 companies surveyed—two did not answer this question and one was an exceptional case.

*The numbers here relate to six companies only, as one company could not project numbers of local researchers in 1995.

SLIDE 6

The 10 UK Japanese-owned labs were also asked how much of their research agendas was determined by head office:

% research agenda determined by head office	*number of labs*
0–20%	0
21–40%	3
41–60%	5
61–80%	0
81–100%	2

Obviously none of these labs is completely independent—they are presumably part of global R&D networks. In addition, they have in general not been established for very long, and this may account for the rather high percentage of the research agenda determined by head office of the two firms answering 81–100 per cent. However, one might expect the percentage of the research agenda determined by the head office to decline over time.

SLIDE 7

Linkages (Number of companies giving answer)

Link with:	*Very Important*	*Quite Important*	*Average Importance*	*Not very Important*	*Not at all Important*
A	4	1	2	2	0
B	3	4	1	0	1
C	0	1	2	4	2
D	2	1	3	1	2
E*	2	0	0	1	0
F	3	3	0	1	2
G	1	1	4	1	2
H	0	3	2	2	2

Source: JETS survey

Nine companies answered.

*Three companies answered.

Linkages with:

A—Your company's central research lab in Japan

B—Your company's engineering labs in operating divisions

C—Other labs in Japan

D—Other company's labs in the UK

E—If your lab is based in a British university, other labs in that university

F—Other UK universities, apart from E

G—UK government labs

H—Other European labs

Examination of witness

DR MARTIN FRANSMAN, Director, Institute for Japanese-European Technology Studies, was called in and examined in the rooms of the Royal Society of Edinburgh.

Chairman

499. Could I start this meeting of Sub-Committee I by welcoming Dr Martin Fransman. We are most grateful to you for your evidence this morning and helping us in our deliberations. We unfortunately are not joined today by the Chairman of the Sub-Committee, Lord Walton, who is unable to be present and I know he would wish me to pass on his apologies as he was unable to join us. Could I perhaps invite you then, Dr Fransman, by way of introduction to say a brief word perhaps about your Institute and then I think you have a short presentation to make to us. I know once that is complete we would very much like to put a few questions to you.

(*Dr Fransman*) The Institute for Japanese-European Technology Studies was set up in 1989 at a reception in Tokyo given by the United Kingdom Ambassador, Sir John Whitehead. That gave us the opportunity to invite many Japanese academics and companies and launch our Institute and get some visibility. The main aim of the Institute, as it's title implies, is to compare industry, science and technology in Japan and Europe in order to learn lessons from this comparison for both sides. We also have to take North America into account because any comparison in this field must involve North America in most cases. Essentially we are interested in both those areas where the Japanese are strong, as well as those areas where the Europeans are strong and the Japanese relatively weak, areas such as pharmaceuticals and chemicals, and the areas where the Japanese are strongest would include consumer electronics, semiconductors, some areas of telecommunications and so on. That is the main role of the Institute.

500. Thank you very much. Would you like to continue with the introductory remarks I believe you have prepared?

A. I would like to make three general points first of all. The first point relates to the interaction between science and technology. The point here, very simply, is that a healthy development of science and technology requires a two-way interaction. This point, I think, becomes apparent when we look at some cases where technology has actually served as the springboard for the further development of science. One case in point is the development of the transistor and integrated circuit which, it can be argued, have done more for solid state physics than the other way around. A very interesting example is the case of Leo Esaki who was the Japanese researcher who won the Nobel prize in 1973 for his discovery of the diode tunnelling effect. Esaki in fact was a researcher in Sony's laboratories and the research that he did which won him the Nobel prize was done partly in Sony in the 1950s. Sony got the licence for the transistor from Western Electric in 1953 and Sony believed that transistors could be used in order to develop a radio. Western Electric did not believe so and felt the only area that the transistor could be used was in hearing aids. In fact, Sony went on and adapted the transistor in order to use it for radios and this involved changing its polarity. In experimenting with ways of doing that they attempted a phosphorous doping method as a way of changing the polarity, and it was that research that eventually led to Esaki's discovery of the diode tunnelling effect. That is a good example of the way in which technology can benefit science rather than the other way around. In short, what we therefore need for scientific development as well as technological development is a healthy technology base and that base, by and large, is found in industry and in firms. This leads me on to the second point and the second point is that Japanese investment in the United Kingdom has tended to complement domestic investment and I think this is a very important point. If we take three examples, the area of cars, the area of consumer electronics and the area of semiconductors: in all three cases we can see that Japanese inward investment has tended to complement United Kingdom investment. In this sense Japanese investment has tended to fill the holes in our industrial structure that for various reasons have appeared as United Kingdom firms have become weak and in many cases exited from industry. The second point then is that Japanese inward investment has tended to strengthen our technology base, thus creating the potential for a further stimulation and development of scientific activity within our country. The third point is that Japanese activities in sales, in production and in R&D can potentially benefit United Kingdom science and technology. To the extent that United Kingdom science and technology is benefited, this will emerge as a result of the interactive linkages that occur between these Japanese activities on the one hand and United Kingdom science and technology activities on the other. With regard to this last point, it must be said that at the moment our understanding of the impact of Japanese investment in production and R&D on United Kingdom science and technology is highly imperfect. We have not yet done the studies that we need to do in order to decisively talk about the impact that Japanese investment in R&D is having on United Kingdom science and technology. Partly this is because this phenomenon is relatively recent. In fact, it is only since the mid to late 1980s that the first Japanese R&D activities appeared in the United Kingdom and in the rest of Europe. We have done a study in our Institute that brings together most of what is known about Japanese investment in R&D in Europe. This is a study that was published recently by our Institute. It is a study that reports not only on the statistics and newspaper reports that have emerged so far on Japanese activities but also contains the findings of a pilot study that we did of the top ten Japanese R&D activities occurring within the United Kingdom. In the rest of my talk I have a number of overheads prepared designed to give you an overview of the role of Japanese investment in R&D in the United Kingdom and Europe and it also shows you some of the results of that pilot study done in our Institute.

[Chairman *contd.*]

You do have copies of the overheads in the folders that I gave you and, if you like, we could examine some of those overheads, but, on the other hand, you may prefer to have general discussions.

501. Dr Fransman, you have very kindly circulated the tables so I think perhaps it would be unnecessary to display them on the screen. As we ask you one or two questions we may well wish to refer to some of the information which we have in front of us and we may ask you to elaborate. Indeed, I would like to do so. In figure 1 you have given us a map showing Europe's location of Japanese research, design and development centres in Europe and it is clear from that that the United Kingdom has a large share of the investment by Japanese companies in Europe. Would you like to give us your thoughts as to why that might be the case?

A. Before I answer that question, can I refer you to the third sheet in the pack which is headed "Table 5: Japanese R&D and Design Activities in Europe in the 1990s." If you look at the third column under 1992 you can see that the United Kingdom has 73 Japanese R&D organisations, 19 of which are stand-alone facilities. The next column indicates that this is 36 per cent of all the Japanese R&D organisations in Europe; so the United Kingdom alone has 36 per cent of all of the Japanese R&D organisations in Europe. Furthermore, the UK has 35 per cent of the stand-alone R&D organisations in Europe. Next comes Germany which has altogether 19 per cent of the Japanese R&D organisations and 26 per cent of the stand-alone organisations. You can see that the United Kingdom is far ahead of the next European country, namely, Germany, in terms of the number of units and it is also somewhat ahead of Germany in terms of stand-alone R&D units. Your question is, why is it that the United Kingdom leads Europe in this field? I think there are two answers to that: the first answer is that many of the R&D organisations referred to in the statistics are related to productive activities that take place in Europe and the United Kingdom the biggest location for Japanese productive activities. If we look at the first table in the pack (it is headed, "Table 2: Japan's Two-Way direct overseas investments with leading industrial countries") you can see that Japan's cumulative direct investment in the United Kingdom amounts to US$15,793. The next country, interestingly, is the Netherlands with roughly US$10,000. After that comes Germany—this is in Europe, of course. All of these investments are dwarfed by Japanese investment in the US which amounts to US$104,400 billion. So you can see that most Japanese direct investment to Europe comes to the United Kingdom and this direct investment is primarily in production and marketing activities. R&D has been an extension of those production and marketing activities. This therefore, is one reason why most Japanese R&D is located in the United Kingdom out of the European countries. The second reason, however, has to do with the quality of United Kingdom university-based research. Our study shows that there are, broadly speaking, two different kinds of Japanese R&D activities that occur within the United Kingdom and Europe generally. The first are R&D activities closely tied to production plants and the second are R&D activities closely tied to university activities. The strength of British university research has also been a major factor encouraging Japanese companies to locate R&D within the United Kingdom. This includes not only the research itself but also the open attitude that United Kingdom researchers have to interacting with Japanese researchers. Many of the major Japanese company R&D managers that I have spoken to from Japanese companies are very impressed with the openness of United Kingdom academics, particularly compared to Japanese academics. The feeling generally is that Japanese universities, under the very conservative Ministry of Education, are not nearly as open to interactions with industry as are United Kingdom researchers. Of course, United Kingdom researchers need funding and the Japanese provide one source of funding. But also, increasingly, Japanese companies themselves are doing very interesting advanced research and so the research itself is also of interest to United Kingdom academic researchers.

Lord Perry of Walton

502. I have two supplementary points. Firstly, you started by saying why they where locating the research and development here. Why did they locate so much of their production here rather than the rest of Europe?

A. That pushes the question one step back. I think there are a number of reasons for that. One undoubtedly very important reason has been the general positive climate that the United Kingdom has provided for Japanese inward investment. This really relates to the second point I made originally on the overhead, namely, Japanese inward investment has tended to complement rather than compete with our own industry. Of course, there are some areas of competition, but this is much more the case than with France or Germany or the United States and it is this which explains the generally harmonious relationship that exists between the United Kingdom and Japan in the industry and trade areas. On the other hand, Japanese inward investment has threatened German, French, Italian or American interests to a far greater extent because it has competed. This is not to the same extent in the United Kingdom. That is one factor. The second factor undoubtedly has been that we speak English and the Japanese speak English much better than they speak any other foreign language and so the language factor has been important in inward investment. The third factor, of course, has been our membership of the European Union and the fact that Japanese companies are likely to have access to other markets within the European Union, given the harmonious relationship that they have with the United Kingdom Government, and those I think are probably the three major factors that account for the large amount of inward investment. In some cases there is a fourth factor and this is that our wage and salary structure tends to be somewhat lower than many of the other major competing countries in the European Union.

503. My second supplementary is probably extremely difficult for you to answer, if at all. Out of the £15 billion which has been invested in production in the United Kingdom, how much of that money

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actually came from sales within the United Kingdom and how much came from overseas sources?

A. That is a good question. I think no data exists that would answer that question. However, Japanese companies that have set up, not only in the United Kingdom but elsewhere sometimes make losses for a number of years and during that time, of course, do not pay taxes since they are repaying the amount of the initial investment. But there has been, in addition to investment financed by retained profits made within the United Kingdom, as I understand it, substantial in-flows of funding from Japan, at least in the initial stages, to finance these investment activities.

504. Presumably there are also in-flows from Europe because many of the sales will be within the Community rather than the United Kingdom?

A. That is right, depending on the case in point, but sales very frequently are in other European markets. That is correct.

Chairman

505. Dr Fransman, the area which is of particular interest to the Committee is Japanese investment in the science base. Having given us those interesting figures, particularly on table 5, would you like to give us your opinion as to what might be the opportunities and also the threats to the United Kingdom's universities in continuing to attract such Japanese investment? There is clearly a good record to date. Are your predictions that it will get better or are there threats that you think universities should be taking a note of?

A. When you say, "it will get better," you mean?

506. The percentage of investment by Japanese companies in research and development in our science base, the percentage of investment in this area?

A. I think it is likely that there will be more Japanese investment in activities relating to the United Kingdom science base in the future. This is likely to slow down over the next few years because of the recession in Japan and the fact that many of the companies are currently making losses. But, nevertheless, this investment is likely to increase in the future as the R&D laboratories set up by the Japanese companies expand. I will come on a little later to deal with the total number of researchers that we are talking about because it is worth putting some figures on that. However, I think that from the point of view of United Kingdom universities, there is very little threat that results from these Japanese activities. There is very little threat for the simple reason that the universities have the option, by and large, in deciding whether they want to interact with Japanese companies and their R&D activities or not. It is up to universities to decide whether they will enter into agreement with Japanese companies and this is the way it operates. A Japanese company will approach researchers—that is how things usually begin—in particular research areas, and the relationship is either a satisfactory one or not.

507. When I talked about a threat, I did not mean a threat of adverse influence on the universities so much as a threat of losing their market share, their share of Japanese investment in European universities and I was wondering whether—at the moment there is 36 per cent investment of Japanese research and development in the United Kingdom—you saw this figure as being held by the United Kingdom or whether you saw a threat of it being eroded?

A. In the longer term it is undoubtedly the case that Japanese investment will respond to a country's level of skills. As the investment becomes more and more complex and sophisticated, as more production takes place within Europe, as more components and inputs are sourced within Europe, the production process and the technologies required become more complex. As that occurs Japanese companies need to take account of the sophistication of the skill base. In this connection, the announcement that was made yesterday by Michael Heseltine about the need for further training within the United Kingdom, and this being an important source of competitiveness, is relevant. In the longer term, Germany will become a major attraction for Japanese companies because of the sophisticated technical skill base that Germany has. It is interesting that companies like Sony, for instance, that have located some of their R&D in the United Kingdom dealing with fields like broadcasting and audio equipment, are doing their advanced television research in Germany. This is an interesting example and shows that we have to be very much concerned with the level of our skill base within the United Kingdom if we are to attract all investment. This is true not only for Japanese and other Western investment, but indeed, for investment by UK-owned firms too because the latter investment is also sensitive to the quality of our skill base. I think Germany over time is going to become more and more attractive—not necessarily relative to the United Kingdom—to the Japanese as they deepen their activities within Europe.

508. Will that be particularly for stand-alone research units or for all research investment?

A. Let me say a little bit about the importance of 'stand-alone' R&D activities. I think we need to be clear about what 'stand alone' means because the statistics are not entirely clear. Supposedly stand alone means that the facility is not located directly within a Japanese plant. In that sense it is separate, it stands alone. If we look at some of the major Japanese laboratories in the United Kingdom, for example Hitachi's laboratory in Cambridge or Sharp's laboratory in Oxford, these are so-called stand-alone facilities in that they are not based within Japanese plants. However, the aim of Hitachi and the aim of Sharp is to integrate these laboratories into the company's activities within Europe as a whole. So the aim is that Hitachi's research laboratory in Cambridge eventually will also respond to the needs that Hitachi has in its production activities elsewhere in Europe. In this sense, even though initially these laboratories have not had very much to do with Japanese productive investments, over time the degree of interaction with the company's European production activities is planned to increase. These so-called stand-alone laboratories are envisaged eventually as being part and parcel of the company's European activities.

Lord Perry of Walton

509. Looking at table 5, in the first column the percentage is 35 per cent and I was looking at what they were in 1990 and 1991 and it was 33 and 30 as opposed to 36, so it has not changed it in any particular direction very much. These are all referring to the number of companies. Can you give us any indication of what proportion of the total spend on R&D is tied up in these different countries? You have given us the figures for the total spend on the manufacturing side but not on the R&D side.

A. Table 5 refers to the number of facilities, not the investment in those facilities. You are asking how much is the spend on these facilities by country? As far as I know, that data does not exist. The nearest we have got to it is on the second sheet which is an overall figure of Japanese R&D spending in Europe as a whole.

510. I saw that, but that does not tell us what fraction the United Kingdom gets.

A. As far as I know, data does not exist that breaks down that R&D spending by country.

511. You have no indication that the really big spenders are elsewhere or here?

A. No, my own impression is that the total value of R&D expenditure by Japanese companies broken down on a European country basis follows very much the same line as indicated in table 5.

512. So the amount of money comes to roughly the same as the number of companies?

A. That is the impression that I have, that is right. So the United Kingdom would have the greatest number of facilities and also the greatest proportion of Japanese R&D expenditure in Europe.

Chairman

513. Can I go back to the subject of threats where we were perhaps talking at slightly cross-purposes and can I take you up now on the original interpretation you put on my remarks where you were suggesting that inward investment in a university by Japanese companies should not be seen as a threat to the university and I am sure we would agree with that. Indeed, we are clear that this has been an important opportunity for many university departments. Nevertheless, you have just told us that the stand-alone investments in research facilities are to be integrated more fully in the companies which are making the investment from Japan. Does this in any way constitute, do you think, a threat to the integrity of the university department?

A. My own view is that these activities do not constitute a threat to the integrity of university research. The reason is simply that while the Japanese draw on United Kingdom university research, they also provide feedback to United Kingdom university research. I think this interaction between university research on the one hand and the application of that research through technology in industry on the other is a beneficial interaction. For instance, to take one example that I know a fair amount about, in Edinburgh University there is the Artificial Intelligence Applications Institute, one of the leading AI institutes in Europe. They have a lot of interaction with Japanese companies like Hitachi and Toshiba. Through this interaction they are able to learn a lot about the machines, the computers that these companies are developing for applications in artificial intelligence. Through that interaction I know that AIAI learns a good deal which is of value to their own work. In this way we see an example of the beneficial interactions occurring between United Kingdom university research on the one hand and applied industrial activity on the other. So I do not see United Kingdom universities being threatened or compromised by the interaction. If anything, I see this as a source of strength. Another example is the research that Hitachi and Toshiba are doing in Cambridge relating to the Cavendish laboratory. In both these cases the companies are working on advanced micro-electronics devices, including quantum devices. The fact that Toshiba and Hitachi are amongst the top five or six semiconductor producers in the world indicates the wealth of technological knowledge that they have. Through interacting with this knowledge base Cambridge researchers (some of whom are British, some of whom come from other European countries) benefit greatly from the knowledge and feedback that they get from major semiconducter producers. I do not see a major drawback to this interaction from the university point of view. From a United Kingdom competitiveness point of view there are other issues obviously that are raised, but I take it your question does not refer to those?

Chairman] No, I was specifically asking whether it might distort the research priorities of the university departments.

Lord Butterfield

514. I would like to make a very short series of remarks about what you have touched on and, indeed, the word "threat". I have been involved for some years now with an Anglo-Japanese research charity and when we began ten years ago it was quite clear that there was quite a lot of innate concern and opposition and real concern in the departments that I knew in Cambridge about whether the appearance in the laboratory was going to result in the sort of thing which was talked about in those days, industrial espionage. I do think that one of the good things that has happened in the last ten years is the very healthy—from a scientific point of view—relationship which exists in Britain with the Americans. I have no doubt it is in part because there has been an enormous amount of traffic with the Americans. We all recognise the Americans made an immense contribution to the saving of our country during the war, although I have a suspicion that the Americans are just as keen on British ideas as anybody else. For example, we know that in Cambridge in the first years of the discovery of molecular biological developments the majority of graduate students that went to the Laboratory for Molecular Biology came from America and there were very few from the rest of the world and I do not think there were any Japanese at that stage and very few from Europe. I do think that insofar as science has an ideal of being an international activity, there has been a very marked improvement, in my opinion, in the relationships that people have with the Japanese scientists. The Japanese have come into this country and have presented themselves as having great similarities with the British. They are an

[Lord Butterfield *contd.*]

offshore island to Asia just as we are an offshore island from Europe. They are strong seafaring people and so on. There have, of course, been major differences in political creeds that have developed, but I personally have the strong impression that relations at the science and the working level are very much better now than they were ten years ago. Another factor which I think is greatly to our advantage is that the result of the war left English or American English the major scientific language for the journals and that too has made it easier for the Japanese coming to this country to read our journals and understand the Anglo-American literature. My main point is that I believe at a personal level the suspicion of the Japanese which I found was really quite marked ten years ago, eleven years ago, is very much less now. Would you like to comment on that?

A. I share that view very much. The reason why it is less now is simply the learning that everyone has gone through over those intervening ten years as more and more collaborative activities have been set up involving United Kingdom scientists and researchers and Japanese scientists and researchers. I think a commonality has been discovered, a lot of common interest, sharing research results, whether the research has come from companies or otherwise, from Japanese universities or other research institutes. It is this common learning experience that I think on the whole has been a very positive one.

Chairman

515. Dr Fransman, you said that you would give us some figures on research workers. Would you like to refer to tables?

A. Yes, let me do that. Table 3, titled research personnel, is very interesting. This comes from the pilot study that we did in our Institute covering ten Japanese R&D facilities in the United Kingdom. We feel that there are approximately ten Japanese activities that do serious R&D, and I emphasise the "R". These are facilities that do significant research as well as development work. The figures that we looked at before show the very large number of Japanese R&D activities in Europe. Most of those do not involve much research as such and, therefore, are not all that relevant for your enquiry, which, as I understand it, relates primarily to science. We believe that within the United Kingdom there are approximately ten Japanese facilities that are doing serious R&D—in other words, including R—and our pilot study surveyed ten Japanese facilities. Table 3 relates to seven out of the ten companies. Two of the ten did not answer the question and one was an exceptional case that we left out. So seven out of the ten companies are included and this table shows the staff of these seven laboratories for 1991. Breaking down the Japanese and the local researchers, and dividing them into technicians, graduates and postdocs, we get a total number of 27 (this is in 1991) Japanese researchers altogether and a total of 78 local, making a grand total research personnel of 105. We asked them, "How is this likely to change by 1995?", and we got an estimate from these companies. You can see that in total the companies expected that they would increase their employment from 105 to 180. One of them could not make a projection and so the stared figures relate to six out of the seven companies. It is interesting that if you look at the expansion of Japanese research employment you can see the total number of Japanese researchers in 1991 was 27. This was expected to increase to 39 by 1995, a small increase but some increase. Whereas if we look at the total number of local researchers, this was expected to increase from 67 to 141. The Japanese anticipate that the research activities undertaken in their R&D organisations in Europe as well as in the United States will be undertaken primarily by locally recruited people. Initially Japanese researchers are sent out to start the research institute, to get it going, but over time the expansion in researchers is intended to take place on the basis of local recruitment. However, we should get some perspective on these overall figures. For the companies in our study we are talking about a total of only 180 researchers by 1995. To put that into perspective, let us look at NEC (Nippon Electric), the computer, communications, and semiconductor company which is in the top six R&D spenders in Japan. NEC has in its central research laboratory about 1,200 researchers and the central laboratory in NEC accounts for only about ten per cent of NEC's total R&D expenditure. If we compare that with the figure of 180 by 1995, compared to NEC alone with 1,200 researchers in their central research laboratory, you can see that the total number of researchers that we are talking about in Japanese R&D facilities at this point is relatively limited. The approach of Hitachi, like many other companies—Fujisawa here at Edinburgh University is another example—has been to begin research in Europe on a relatively small basis with a small number of researchers and then organically, as it were, to let these research activities expand as the company's activities within Europe increase. We are talking about fairly small beginnings. Sharp has got a rather larger laboratory. Their approach has been to establish a rather bigger laboratory in one location. Hitachi also has a laboratory in Dublin in addition to Cambridge. Their approach has been to set up a number of smaller R&D facilities in Europe.

516. But, of course, the Japanese, do they not, have a tradition of working with people they understand and know and they start on a small scale perhaps in order to establish a relationship? Would you think this was true in this case, that once having established a presence and understanding it better that they are likely to build on it?

A. I think the point you have made is absolutely right. For the Japanese the key starting point is the quality of the relationship that exists. In all cases the Japanese company has had initial contact with researchers at that university first. As research collaboration begins, initially on a very small basis, a relationship is built up and through this relationship the Japanese company discovers whether it can trust the researchers and work with them. In this sense, as in Japan, the quality of the relationship is crucial. It is seen as a long-term relationship and this is exactly, as you have said, the way these research facilities begin. On that solid foundation it is hoped that research activity will expand, but the Japanese feel

[Chairman *contd.*]

that the *sine qua non* is that there must be a good trustworthy relationship that underlies this.

Lord Perry of Walton

517. On the map there is a phrase in the bottom line that I do not really understand. It says: "*Italics = University-based unit (United Kingdom only).*" Is that because there are only university-based units in the United Kingdom or is it because you do not know about the ones in Europe?

A. Essentially the latter. We do not know. This in fact is something which deserves comment. It is very interesting that the DTI does not have detailed knowledge of all the Japanese activities in R&D in the United Kingdom. The European Commission does not have detailed knowledge. They cannot tell you in detail. There are snippets here and there but they do not have detailed information themselves of Japanese R&D activities. This is a really glaring gap.

518. From the names we do know that quite a lot of them are involved in production in the overseas ones, but there is no indication whether any of them are in universities?

A. That is right. We do not have, as I have just said, an indication of the interaction between these other European facilities and local universities. We know much more about the United Kingdom as a result of our pilot study and other more informal discussions. Of course, it must be pointed out that the link is not only with the nearest university. For instance, Hitachi (Cambridge) has got very close links with Imperial College and Glasgow University as well, so usually the company's research facility and its neighbouring university forms part of a network of linkages that include quite close interactions with other universities as well.

519. But Hitachi is mentioned both in Germany and in Italy. Do we know if in either of those countries they have university connections?

A. Hitachi have a facility in Düsseldorf and in Italy they have a facility. Neither of those facilities has a large research role. That we know. There is likely to be some university interaction, although the nature of that interaction we do not know. Hitachi's only facilities with an important research role are those in Cambridge and in Dublin, not the German and Italian facilities.

Chairman

520. I wonder if I could ask you to comment on the range of recent Government initiatives. There are a number of initiatives both by Government, by the Royal Society and by others. Would you like to comment on those initiatives and indicate which such initiatives you think might be helpful in the future?

A. Some of these initiatives are primarily intended to facilitate trade and do not have very much bearing on scientific or research interactions. That includes, for instance, the DTI's Priority Japan initiative which is primarily trade based, although there may be some scientific interactions that follow from that. The "Engineers to Japan" scheme is a very important scheme though still relatively small. It is particularly small compared to what happens in the United States or France. France is perhaps a better comparison being a similar sized country and located within Europe. The French take very seriously the priority to send engineers and technical people to Japan. The CNRS in France does a lot and many researchers are sent and actually given very good conditions in Japan, in terms of salary, when they go. These programmes are extremely important because they send United Kingdom engineers to those industries where the Japanese have strong international competitiveness. The other programmes such as the programme mentioned here run by the Royal Society and the British Council, that attempt to increase collaborative links in research between Japanese and United Kingdom researchers, are also very important. We said a few minutes ago that often longer-term collaborations begin in very small ways through interactions between researchers. Of course, most of those interactions do not result in big facilities later being based in the United Kingdom. But some of them do and I think these forms of collaboration which the British Council and the Royal Society are helping to establish are important. The question overall however, is whether we are doing enough in this area and whether there are sufficient resources to encourage these collaborations. It must be said that the resources involved are still very modest. There is a cost benefit question here, namely, whether we would get sufficient benefit by furthering these activities in order to justify the cost and, of course, if so, who will pay the cost at the end of the day?

521. What is your view on that, leaving aside who is going to fund it? Do you think that greater effort might be rewarding?

A. I think Government has an important role to play in facilitating the initial contact because often the problem is one of lack of information. Researchers here are doing things that may fit in well with possible collaborators in Japan, but they do not know who these people are and so initially there is often a lack of information and these kind of schemes help to overcome this information deficiency. My own view is that these programmes are making an important start and ought to be, as time goes on, expanded in order to meet what I foresee will be a growing demand for international research and technology collaboration.

Lord Butterfield

522. I agree very much with the need to increase the traffic of scientists to Japan. A major problem we have found is that living in Japan is very expensive. If we send some artists over to perform they can very often recover some of their costs by gate money, admission money, but when you want to send a scientist over then he usually needs units of a month, perhaps a week would help, and finding the funds for the air fare, as it has to be, and accommodation in Japan certainly mounts up. It will be several thousand pounds to send someone over and it is really an investment gamble: you do not know whether the man you are going to send is going to have a good personal relationship with the people at the other end and how the university is going to look at linking with the British university from which the worker comes. I personally feel that more could be

[Lord Butterfield *contd.*]

done, but a limiting factor in my view is the expense of sending people all the way across the world and then lodging them in Japan. America is not so far and when they get to the other end it is so much easier for accommodation to be found in the universities because so many of the universities have student accommodation on which beds British scientists are very happy to sleep. In the Japanese universities they are very much dependent on home resident students and so there is not that facility. Furthermore, of course, accommodation in Tokyo, for example, is very very tight and I think it would be unreasonable to expect professors in Tokyo universities to offer personal hospitality because of the construction of their homes and the whole business of the noisy European snoring the other side of the paper wall! I would be very interested to hear if you feel that expense is a very important limiting factor on initiating contacts between the two sides?

A. It must be said that over the last ten years or so the Japanese have done a great deal to attempt to expand the possibilities for visiting scientists. The Science and Technology Agency (STA) has a scheme that pays for visiting scientists. They work together with the Royal Society, as you know. Perhaps less well known, MITI also has a scheme for inviting foreign scientists to its laboratories and through our contacts we have sent a number of researchers from Edinburgh University to these laboratories. Japanese companies have developed their own schemes. For instance, Hitachi has its HIVIPS programme that encourages researchers to come to Japan and pays for them. Through all of these mechanisms there are an increasing number of ways of funding, from Japanese sources, scientific visits to Japan. The Japanese are obviously embarrassed that they send so many more scientists out to the west than they receive from western countries and it is an attempt to remedy this imbalance in trade, if you like, in scientists that lie behind these programmes. It also has to be said that very often there is not sufficient will on the part of western researchers to go to Japan for the period of time that is necessary in order to do good collaborative research. The reasons are very obvious: schooling for children, the language, accommodation, the high cost of living, all present difficulties. Very often scientists are willing to go for a two/three-month period. But if you are to set up a fruitful collaboration (and that requires getting to know your collaborators) sufficient time is necessary; probably at least a year, if not more. Two or three years are ideal. Very few western researchers are willing to make that degree of commitment. On the other hand, of course, the Japanese do and so they come to Europe, they go to the United States. One may argue that the entry barriers are easier for them than they are for westerners going to Japan, but be that as it may. For a long time, really from the Meiji Restoration, they have made that commitment. What we need to do in the United Kingdom is to have career paths worked out whereby we get our scientists and engineers to learn Japanese during their first degrees, as part of their engineering degree or physics degree. We then need to enable them to move on to placements within Japanese companies or Japanese universities and eventually be in a position where they can benefit fully from the undoubtedly important technolgical and scientific work that is occurring in areas in Japan. Although some schemes along these lines exist in the United Kingdom, we need to be more systematic in learning from Japanese strengths.

Lord Nathan

523. Dr Fransman, you opened by referring to the attractions of this country because of the openness of the universities. So far as the openness is concerned, does that mean that the Japanese in effect enter upon the entire knowledge within the university system here as opposed to having arrangements with regard to a particular piece of research? To what extent is this disadvantageous in this country in that the Japanese may be acquiring our whole underlying knowledge and know-how in the field?

A. If one looks at the situation closely what one finds is that knowledge is to a very significant extent tacit and very difficult to pick up. What tends to happen is that Japanese researchers interact with particular researchers, in particular laboratories, in particular universities, and through that interaction learn what is happening in these places. It is extremely difficult to find out about the neighbouring areas of research which these researchers are not directly involved in. Even reading the results published in academic journals will only disclose a very small proportion of the total knowledge that relates to that research. A large part of the knowledge remains tacit. And so I think the idea of the whole knowledge base suddenly being available, as it were, for exploitation by others is not quite the way it happens. It would therefore, be wrong to say that through their activities in the United Kingdom the Japanese have access to the country's entire knowledge base.

Lord Perry of Walton

524. It would be equally wrong to assume that the Japanese companies are investing in British universities from sheer altruism?

A. There are cases where funding has been given for public relations reasons. But generally speaking Japanese companies, like all companies, are very hard-nosed and they look very closely at their own self-interests.

Lord Nathan

525. You refer to the close relationship between technology and science and to some extent developments of technology can lead to increases in scientific activity. To what extent do you consider that these factors and those you have mentioned put British scientists, be they in universities or not, in touch with technology and thus enabling British industry to take advantage of that technological know-how as opposed to scientific know-how?

A. That is an extremely interesting question you are asking and that was very much behind the first point that I was making. I think a major problem for United Kingdom science is that our technology base in particular areas has been eroded. This is certainly true in semiconductors and consumer electronics, for instance. This is a negative factor for our science as

[Lord Nathan *contd.*]

well as for our technology, and for our industry and our competitiveness. In the longer run my own view is that Japanese investment will help to some extent, though not completely, to plug these gaps that have emerged in our industrial and technology base. My hope is that UK science will benefit from the interaction that will occur between scientists and those involved in these technologies in these industries. Will a stronger science base benefit other parts of industry located in the United Kingdom? That depends very much on the interactions that exist between this industry and the scientific activities that occur. We only have to look at pharmaceuticals in the United Kingdom to see wonderful interaction occurring in the way it should occur between science and technology and industry. That works very well in the United Kingdom. In some areas of chemicals it works very well too. At the moment, however, it does not work as well in physics-related areas, partly because of our industrial base. I would hope that in the future Japanese industry can stimulate scientific research through their activities not only in the United Kingdom but also elsewhere in Europe, and that this will help to create further opportunities for other United Kingdom-based industry. If that was behind your question then I agree very much with it.

Chairman

526. Dr Fransman, we are running out of time. Can you recommend further actions by Government or the universities, or indeed anyone else, which would make the United Kingdom an even more attractive location for inward investment?

A. Let me summarise by saying very simply that the key point here is the interactions that occur between United Kingdom science and technology and these Japanese activities and we need to do as much as we can to encourage these interactions. In part it is a question of contacts, at first informal, later more formal, between United Kingdom and Japanese scientists and technologists. We need to look at these contacts more systematically than we have in order to evaluate their benefits. I should also say, finally, that we need to know much more than we do about the impacts of Japanese investment in production and R&D on United Kingdom science and technology. The studies that have been done at the moment (and I am very aware, the study that we have done in our Institute) simply scratch the tip of the iceberg. We know very little at present about the impact of the Japanese on United Kingdom science and technology. Research is needed in this area. In fact, it is very difficult to fund research in this area. We have been talking to the DTI and to the European Commission for a long time. They are interested in this detail. They do not have it, but it is very difficult to get funding for this kind of work. At the moment, to answer your question, we lack the research that is needed to give an informed answer to that question. Research is very urgently needed but apparently very difficult to fund.

Lord Perry of Walton

527. Do you think there is a case for the establishment of other institutes like your own covering the Pacific Rim countries, Taiwan and Korea, both of which are catching up with the Japanese or indeed with America, or indeed again with China?

A. My own view is that we need a number of different institutions to study these things. The more institutions there are, the more variety of opinion and ideas there are. Institutes like ours try to stand back, as it were, and look at the general picture and analyze. There are in fact very few places that do this, as opposed to the DTI, for instance, that is involved much more on a hands-on basis: not standing back and saying, "Let's look at the whole picture, what sense does it make?" There is so much happening in the Asia Pacific area that there is no shortage of topics to examine. However, there is a great shortage of people to examine these topics. Look at China, for instance. The rapid changes occurring in the Asia Pacific area require a whole range of studies and interaction with other institutions around the world with a similar interest. In fact, there are not that many.

Chairman

528. These other countries who might be moving into this field, do you think they will follow the same pattern as Japan or has Japan got something which is essentially different in thier *modus operandi* of inward investment?

A. That is a very interesting and difficult question. There are some aspects of Japanese forms of organisation and interaction that are Japan-specific, but I think this is not going to prevent countries like Korea and later countries like China acquiring very important competencies in science and technology through gradually building their skill base, by training engineers, by investing in R&D, by setting up research institutes and acquiring the latest science and technology. This will inevitably occur in many places in different ways from Japan. Japan has got strengths and weaknesses. We have not had time to talk about this. Some of the strengths have been very important but there also are important weaknesses. The path of other countries will be different, but I do not think this will prevent them also from acquiring significant science and technology capabilities in particular areas into the next century.

529. Dr Fransman, as I said just now, I think we are running out of time. We could, I know, have continued very much longer. We have learned a lot. We found it most interesting. Thank you for the information you have given us. We will be able to study this at greater leisure on our way home perhaps. You have made a powerful case for more research. Sadly, it is not in our means at least to fund it, though perhaps we might consider recommending it. Thank you again for your help.

A. Thank you.

Examination of witnesses

PROFESSOR MAXWELL IRVINE, Principal of Aberdeen University, PROFESSOR ALISTAIR MACFARLANE, Principal of Heriot-Watt University, DR DAVID KENNEDY, Principal of Robert Gordon University, and PROFESSOR JOHN ARBUTHNOTT, Principal of Strathclyde University, members of the Committee of Scottish Higher Education Principals, were called in and examined in the rooms of the Royal Society of Edinburgh.

Chairman

530. Good morning, gentlemen. Perhaps it would be helpful if you would introduce yourselves so that we know who is who?

(*Professor Arbuthnott*) I am Professor Arbuthnott, Principal of Strathclyde University. On my left is Principal Irvine from Aberdeen University; Principal MacFarlane from Heriot-Watt and Principal Kennedy from Robert Gordon University.

531. Thank you very much for that. Could I start then by thanking you very much for joining us this morning. You will know that we are conducting an enquiry into international investment in United Kingdom science and we are minded to try to encourage investment of an appropriate nature and in order to do that it is clearly helpful to know from you what the opportunities might be, as you see it, and indeed what the threats might be. So in general terms I wonder whether perhaps you would like each from your respective universities to give us just a thumb-nail sketch as to where your university stands in this and how you see it?

(*Professor Arbuthnott*) Thank you very much, my Lord Chairman. We have produced written answers to all the questions, both the first phase of five and the second phase of eleven. I do not know whether these have reached you, but it is printed material and it can be left at the end of this meeting. I certainly will be leaving my material and I think some other principals will also be adding to that. We have exchanged some information between us and we will not all talk about every aspect. I take it we will be going systematically through the questions that you have set?

532. I can tell you that there is no likelihood of that!

(*Professor Arbuthnott*) That gives us the level playing field! From my point of view, our university regards our international research business as a very important element of our university's activities. Our involvement with overseas research and in particular with European research, is extensive. To give you just a thumb-nail sketch of the extent of it, in summarising international research contracts and science and engineering since 1991 taking three different aspects, private investment, ie, from companies, public investment (that is including the European Union) and Government investment from overseas; the total for private investment amounts to £3.236 million and that covers activity in Belgium, France, Germany, Holland, Ireland, Japan, Switzerland and the United States, with the others being rather smaller. In terms of public investment, the total for the period is £8.773 million and by far the largest element of that, £8.3 million, comes from EU supported research projects. Allied to that there is £2.6 million of EU training and education support. The next most major is the United States of America at £338,000. Government support is at a much smaller level, £672,000 for that period, giving a grand total for research of £12.6 million and for research including EU training and education, £15.2 million. You can see that over that period of time overseas investment has been very important for us. I would just conclude this first response by saying that the income from international licensed intellectual property since 1991 for our university is £8.426 million. The largest element of that comes from the United States through the Burroughs Wellcome Company (United States), £6 million. There are smaller amounts from other American companies. The second largest amount comes from Europe, from the Wellcome Foundation Ltd at £2 million and the split is shown in the evidence I shall leave to the Committee. That is my thumb-nail sketch.

533. Thank you very much. Shall we hear from Aberdeen next?

(*Professor Irvine*) Principal investment from overseas into our recurrent funding is from the European Union about ten per cent of the total funding. We are very strong in the European Social Fund, £1.3 million a year. In 1993 new awards under framework initiatives were £2.5 million a year. Perhaps I could give you a little case study. I choose magnetic resonance imaging in hospitals. This was a development which took place in three British universities, the University of Aberdeen being one of them. It was licensed. The patents were taken out for the university. It was touted around British industry. It is now a £1 billion a year industry. There were no takers in the United Kingdom. We do very well out of the international licensing. We earn about £1 million a year now, but we are coming to the end of that licensing. The point I would like to make is that there are innovative things happening in our universities. It is very difficult to get British industry to take them up. I do not wish to repeat a lot of statistics but if I could just make one other point which I think you will find repeated over and over again from all the universities, and that is, European funding we see as being essential. On the other hand, it does not pay for itself. That is, under the old dual-funding system universities that won research contracts with the Research Council funding in the United Kingdom or charities received in their block grants the following year a notional 40 per cent overhead. There have been changes in recent years with the transferring of some of that money to the Research Council and it comes back in the research grants, so it is a bit more complicated. With regard to money that we got from commercial contracts, we received a smaller amount, it being assumed that we charged the commercial partner in the contract, the overheads. We used to get about a four per cent allowance for that. Under the European funding rules we can only claim a 20 per cent overhead maximum. This does not pay for the well-found laboratory. Since we no longer have well-found laboratories supported by our block grants we have a problem. The funding from the European Union for research undertaken on their framework initiatives does not fully cover itself and I think this complaint

[Chairman *contd.*]

has been made in a number of places. You could be very successful in Europe and make yourself bankrupt.

Lord Butterfield

534. Is that because Europe thinks most of the research is going to be social research?

(*Professor Irvine*) No. I believe that in most European countries universities that are successful in winning European fundings are supported by their governments, whereas that is not the case in the United Kingdom.

Chairman

535. On this issue of EC funding, it is an area I think the Select Committee on another occasion will wish to look at but it is slightly out of the remit of our investigation today. It is nevertheless most helpful to understand some of the constraints under which you are operating.

(*Professor Irvine*) The last point that I would make is that my university, as with many other universities, has two companies set up to exploit our intellectual property rights and, in addition to the funds that come directly to the university, those companies are earning significant sums of money abroad. One of our companies earns about 50 per cent of its income, £1 million a year, from overseas consultancies, and one of the biological bio-tech companies that we have spawned, ScotGen, recently went into partnership with a Californian-based organisation and 50 per cent of its capitalisation came from the US.

536. Just to elaborate that last bit of information, could I ask whether these companies derived any of their income from licensees given by your university or whether it is all consultancies?

(*Professor Irvine*) No, ScotGen is licensing its products.

537. Thank you. That is helpful.

(*Professor Arbuthnott*) My Lord Chairman, the income that I referred to from overseas exploitation of IPR was from licensees.

538. Can we move to Principal MacFarlane?

(*Professor MacFarlane*) Certainly. Heriot-Watt gets about 17.1 per cent of its research and contract income from overseas and about 15.2 per cent of that is from the European Union. To turn that into figures, from European sources we get about £1,558,000 out of a total research grant and contracts of just under £10 million. We are involved in several of the European framework programmes which we regard as very important in keeping our research work in the context of these major European developments. We also get money for a specific training exercise from the European Social Fund. We train people in certain aspects of digital and educational technology. We do not have any long-term overseas support in the way that some other universities, like Edinburgh, for example, does. We treat overseas contracts exactly the same as we treat United Kingdom contracts. My contracts officers tell me that they make no essential distinction. We do, as much as we possibly can, retain total control of the intellectual property rights. The only specific policy issue that I can find is that we do have some legal difficulties arising from interpretations of various aspects of contractual law. Scottish Enterprise has made no significant contribution or difference to any of our activities in this area. Although it is not specifically for research, the university did win a Queen's Award for export for some of its educational courses and I simply mention that to say that I believe that exporting education and training will be significant in the context of overseas work. What the Government could do to help and increase our research income from overseas I think is principally in two areas: one is to foster our basic strengths. We have to compete in an extremely competitive overseas market and therefore it is necessary for us to build up very significant strengths in certain key areas. I think it might also be helpful if various Embassies were brought into play to help build up contacts. Again, although I am slightly straying from the brief, I think there is a huge overseas market in exporting education, special forms of courses, particularly supplied by distance learning and it would be very useful to use the contacts which could be brought out through Embassies in that way. These are the general points I wanted to make. In respect of Research Council contracts, I have another set of points I would like to make in relation to overseas students.

539. Perhaps we can come back to those in a moment. We have covered a large number of areas which I am sure we shall wish to return to, but that is helpful as an introduction, thank you very much. Lastly, Principal Kennedy?

(*Dr Kennedy*) Last and perhaps least, too. As a new university we are in a fairly embryonic state and I think that would be true of the other new universities in Scotland. I suppose we bring in about £600,000 in overseas contracts in research, including postgraduate students. It is fairly patchy. I think in our case we are particularly interested in pharmacy and in off-shore engineering and it is in those areas that most of our attention is focused. I think like the University of Aberdeen we have two companies which trade internationally and, also, I think like Heriot Watt we have a very considerable interest in selling science and technology education abroad and there is a lot of investment going into that. Overall, being in a new stage of development we see the advantage in international trade very much as an additionality. It gives us the potential of doing things which we would not be able to do if we were dependent solely on funding from the British Government. So we certainly see some considerable advantage to us in helping to develop our science base and in that sense I think some of the questions that were put down, sort of selling things on the cheap, I would not see that as the case at all. I see it very much an opportunity for us to develop our wherewithal to the benefit of Britain.

540. Thank you very much.

(*Professor Arbuthnott*) Could I come back briefly on a couple of points that have been raised by my colleagues on the right just to report two other Queen's Awards in our university, one for drug discovery and one for the distance learning MBA programme overseas. This brings me to the point that

[Chairman *contd.*]

my colleagues made about the international trade in education. I do think that the Scottish universities are developing further their distinctiveness. As you know, we are now funded separately by the Funding Council for Scotland and we have our own COSHEP, Committee for Scottish Higher Education Principals. I think there is considerable potential for further extension of the trade in education from Scotland outwards. I certainly do not think that the "distinctiveness" of the Scottish higher education system is emphasised as much as it might be by Government departments or by the British Council. One could ask why should it be? If you think demographically, within the United Kingdom, Scotland should account for about 9.6 per cent of the higher education numbers but in fact we train over 14 per cent, so a large number come from south of the border and we think there is room for a continued healthy intake of students from overseas. We would like as a group of universities to promote that from Scotland.

541. So if we could pursue that point for a moment because it is an interesting thought. The distinctiveness and the reputation, of course, of Scottish education is something which needs to be exploited rather more thoroughly. Who should do that?

(*Professor Arbuthnott*) I think that we are doing that as individual universities. We have just established a Strathclyde University office in Kuala Lumpur. We have just appointed a member of staff to serve in that office; he will be the link person for Malaysia, Singapore, Hong Kong and other parts of South East Asia. That is an industrial initiative. I believe there is scope for more co-ordinated activity and I think much of that depends on joint planning between the heads of the universities. We do need Scottish Office practical help in promoting that, in my view. There are start-up costs in such venture which are quite small in connection with the reward that we can generate from such activity. With Aberdeen University we are promoting jointly a programme of work in another European country, another example of a joint venture of the universities. As Principal MacFarlane said earlier, so far very little support for that activity has come from Scottish Enterprise, though some has come from local RECs eg GDR. I would share his view on that. I do not know about you, Maxwell?

(*Professor Irvine*) The office that John Arbuthnott has referred to, we are negotiating whether it should be a joint office. There may be other partners that we would wish to come in to that. We do see it as a way forward for the universities, not to duplicate effort but to complement each other in this area. I do think that Scottish Enterprise could do more in this area and I think that they are planning to do so, but so far we have not seen any of the benefits really coming through to us at this stage.

Lord Perry of Walton

542. Could you not sell the Scottish degree system more easily because it is so much more like the rest of the world than the three-year honours programme in England?

(*Professor Arbuthnott*) I think that is a very strong feature.

(*Professor Irvine*) We do have a problem in one area and that is that we are particularly strong as a group of universities in medical education. That has been a historical fact, the fact that over 20 per cent of medical education is in Scotland, but, of course, their manpower figures are very strictly controlled. Most of us with medical schools are under bombardment from overseas for new schemes that would allow us to use our expertise. Most of us are entering into agreements with countries abroad where we would have pre-clinical training here and then supervised clinical training abroad. I am not quite sure to what extent the restrictions on overseas student numbers in the medical schools are driven by the problems of clinical provision within the health service and to what extent we are really being asked to implement Government immigration policy.

(*Professor Arbuthnott*) We have to combine prudence, my Lord Chairman, with enterprise. There are political uncertainties in overseas countries and in the past there have been disturbances and, indeed, wars which have greatly affected the flow of students and the flow of income therefore. All of us, I would say, exhibit a very prudent attitude to the overall percentage target that we expect this business to account for in terms of our income and expenditure. We are not in any way launching into this at the expense of teaching United Kingdom or European Union students. This is additionality with good management. I think what we are saying is we would like to work more together in doing it.

543. Do you give data on the numbers of both undergraduates and postgraduates in the different faculties in your responses?

(*Professor Arbuthnott*) Yes.

Chairman

544. I wonder then if I could move the discussion on to a different area which has been touched on by some of your introductions and that is any correlation there might be between the regional economy and the attractiveness of your particular universities for inward investment. We have heard, for instance, in Wales, when successive Secretaries of State were successful in regenerating parts of Wales it had a noticeable effect on the inward investment in the university sector. I wonder if you would like to comment on that and perhaps you might wish to elaborate on some of your observations on Scottish Enterprise's role?

(*Professor MacFarlane*) We at Heriot-Watt have a research park which is very well established. There are about 1,000 graduates employed on that research park and there are something approximating 50 separate enterprises on it. One of them, Syntex, is a very large international pharmaceutical company and I understand by talking to Syntex that it was the direct proximity of the university which was attractive to them in making that particular investment. As a university we have been involved in inward investment. When Motorola were considering first of all moving to Easter Inch and then expanding their activities I was involved through the Inward Investment Unit. When Intersat

[Chairman *contd.*]

(the International Satellite Organisation) were looking for a new headquarters we were considered and I spent some considerable time talking to people like that. So first of all by direct involvement and, secondly, by observation and experience. I think that the existence of scientific and technical activity of this standard that is done in the Scottish universities is a very significant attraction for inward investment. That is my personal view. More generally, I think it might be helpful and useful if I can suggest to you that some of The Scottish Office Ministers could perhaps make overseas promotional visits. There is a feeling, rightly or wrongly, that some of the things which the Scottish sector has to offer which are quite distinctive are submerged when viewed from an international perspective. My personal view is that to get more inward investment we should get more co-operation amongst Scottish higher education institutions, not least in the production of very high quality promotional material which covers the whole Scottish higher educational sector.

(*Professor Arbuthnott*) The Scottish Electronics Forum is being promoted by Scottish Enterprise. Scottish Enterprise have recently, as you probably know, been looking at the top five or six industrial commercial activities of Scotland and electronics figures high in that. I would like to give one example: our university runs a programme called ITACS which is really a tailored educational programme for the IT electronics area. I think all the major companies are now members of that consortium and we deliver tailored educational programmes for them, sometimes within the university, sometimes on site and I am certain from my knowledge of the response of Digital to that programme ITACS that was a factor in Digital (perhaps a minor factor but nevertheless a factor) relocating in Scotland and we are very much involved with that company and we are very pleased that they have moved out of Ireland into Scotland. In relation to co-operation, Principal MacFarlane's university and my own university have introduced an integrated graduate development programme for the manufacturing industry in Scotland which I think is unique, which we are promoting jointly together. The aim is to train, in modules, senior and middle management in different branches of manufacturing. The programme (STAMP) is at an early stage but it is going very well and it is an example of co-operation. I would agree that we can do more to co-operate. Speaking of Ireland, as I was thirteen years there working quite closely with the Irish Industrial Development Agency, I have to say that coming back to Scotland I see less coherence and evidence of joint activity between the whole of the educational system here and our Locate in Scotland and all the other inward promoting activities than I saw in Ireland.

Lord Perry of Walton

545. We have been told by others that in pharmaceuticals and chemicals we have got active technology as well as active science and the two things interact but that in physical science the physical research is inhibited by the lack of the physical technology because of the depression of the physical industries. Is this equally true in Scotland because they talk of the Scottish "Silicon Valley" as if there was quite a lot of physical science and physical technology going on?

(*Professor Arbuthnott*) I would lead off in answering that by saying that I understand the point you are making but I do not necessarily agree with it. If I can take an example of optoelectronics, I think Scotland is in a position to be leader in opoelectronics. There are some areas where Scotland can be a world leader and a world player. I think Scotland is a world player in research. In this particular area physical science undoubtedly is. We have just started a spin-off company called Microlase which is making solid phase laser devices and selling them to America. That is a difficult thing to do. It is always difficult to have new start-ups, but the potential is there.

546. We were told this about the south. I was wondering whether you were going to make the point that it was different here?

(*Professor Irvine*) I perhaps slightly disagree. I think there are centres of excellence and I think optoelectronics is one where potentially we could be in a leading position, but I think the general thrust of your comment is correct, that while there is the "Silicon Glen" it is largely a fabricating activity. Most of the companies are foreign companies and their research bases are outside of Scotland and, therefore, we do not get the same synergy between the industrial research laboratories and the universities which, for example, you would get in Stanford. We do not get that same synergy in Scotland and I think as long as the principal electronics companies in the area are foreign based it is going to be very difficult for us to overcome that. Could I just touch on two regional elements? In Aberdeen, of course, there are two elements; one is always associated with oil and gas and there is no doubt that the strength of the oil and gas industry is reflected in the universities, and I am sure David Kennedy would say the same thing, that we do gain from inward investment because of the presence of the oil and gas industry in Aberdeen and the health of that industry is important, I think, to the health of the universities and to the health of the economy generally in the area. That does allow us, for example, to go in partnership with companies which are in Aberdeen when they move to production outside of Aberdeen. For example, the Shell company which is very strong in Brunei is taking our activities in partnership with them to Brunei as they win contracts there and we gain certainly from that. The other regional issue I would like to raise with you is the fact that in Aberdeen the other strength is in the presence of a high concentration of research institutes. We have the Rowett Research Institute which is a food and nutrition institution, we have the Macaulay Land Use Research Institute, we have the Marine Laboratories, the Torry research station and we have the Institute of Terrestrial Ecology. That group of institutes collectively with the university is environmentally active. It has a very high concentration of environmental scientists, one of the largest in Europe, and we have recently been short listed as topic centres in seven different areas for the new European Environmental Agency. We would

[Lord Perry of Walton *contd.*]

like to see that regional strength protected. Many activities in the United Kingdom suffer from not getting to a critical mass. We have by accident, history, got in this region a critical mass which we think can make us a world player in environmental studies and we are co-operating, but we are aware that there are debates going on as to how these institutes might be organised on a Scottish or a United Kingdom basis, and we see the plans that we hear talked about as weakening that regional strength we have by co-operation in Aberdeen. It is complicated by the fact that we all have different funding masters; there is the Scottish Office Agriculture and Food department, there is the Ministry in London, there are the Research Councils, so to get all the players on side in a regional context is a difficult one. We think we have made some progress in that and we were fearful that that may be disrupted by a larger United Kingdom firm.

Chairman] You have opened up a very large subject here!

547. Before you open it up, could I go back for one supplementary question. In pharmaceuticals and chemicals a lot of the activity is not with British companies, it is in fact with overseas companies and they do get involved in R&D. Why do the overseas companies in Silicon Valley not get involved in R&D?

(*Professor Irvine*) They do, but I just do not think it is to the same extent that it could be. The fact that we have got world players in the pharmaceutical and chemical industry which are United Kingdom based is a great help and it builds the strength and therefore the others come in. I do not think we have that sort of background support from the United Kingdom physical science companies to the same extent.

(*Professor Arbuthnott*) I think the reason for the R&D pattern of spend by these multinational physical-science-based companies is part of their global plan. They do not see it to their mutual advantage to invest in high cost R&D activities in Scotland. It is as simple as that. There is a danger in relation to pharmaceuticals that we can be too complacent. With new bio-technology developments which require the exploitation of genetic engineering it is important to remember that the European guidelines for developing this work are different from the American, as you well know, and there is now some evidence emanating from the Royal College of Veterinary Surgeons last week at their Charter 150 meeting expressed by the pharmaceutical companies. Such companies are becoming impatient with these European bureaucratic rules and that they are moving their research out of Europe, not just out of the United Kingdom and I think that is a considerable worry.

Chairman

548. I think it would be helpful if people just for the moment concentrate on these regional issues.

(*Professor Irvine*) I only meant it in that sense that this was a particular regional issue.

549. We will certainly come back to the Government research establishment scrutiny exercise and I am sure you will wish to amplify your remarks on that later.

(*Dr Kennedy*) Coming to the regional economy, it seems to me that it has been the regional council which has done most to promote the region abroad in the sense of the offshore petroleum industry and the other body, the Scottish Council for Development in Industry, which has manned quite a number of trips abroad. In some senses I think Scottish Enterprise National while it has gathered together a body of information pertinent certainly to the oil industry abroad which is useful when you are looking for exports, it has not done too much in the way of promoting the scientific technological base that is now available in order to help sales abroad and that is disappointing. I think that has been done much more by the Grampian Regional Council which has had expeditions to various parts of the former Soviet Union, China, South America and so on and it is disappointing that Scottish Enterprise National has not undertaken that quite so vigorously.

(*Professor MacFarlane*) Could I make two regional points? First, Heriot-Watt is very much involved in petroleum and offshore engineering work and, strangely enough, this requires massive computing investment and we have been very fortunate in getting support from a number of companies, oil companies and computer companies, in building up very very powerful computing resources to study reservoir development and so forth. The specific point I wanted to make in that context is that the move of the new European intensive computing centre to Edinburgh has had an enormous and immediate impact. It has put this activity in an absolute world class. Secondly, one of Scotland's major industries is the whisky industry. We have an international centre for brewing and distilling and for some years I have been trying very hard to build this up and strengthen it and we have done one thing which has been successful and we are trying to do another thing which may be successful. The thing which we have done is linked up with the Brewing Research Foundation International in Redhill near Gatwick where we now have them associated with us and this is proving very valuable indeed. We are working out a joint and co-ordinated research programme. That has given us a very great strength in brewing. Based on that, we have been negotiating for about 2½ years with the whisky industry and the basis of the negotiation was to try and get them to move their research work onto our campus. The particular point I wanted to make is that one very difficult but potentially enormously effective way of building up international class strength in certain areas is to combine on the campus industrial research and academic research. All I can say is that that is a very hard thing to do, but we may be about to be successful in the case of this particular industry.

Lord Butterfield

550. Are you making any links with the Japanese in this kind of industry?

(*Professor MacFarlane*) Yes. We actually do research with Suntory. We have a Japanese colleague

[Lord Butterfield *contd.*]

coming from Japan to work in this institute. It is truly an international centre.

(*Professor Arbuthnott*) Briefly, two other examples that the Committee may be interested in, my Lord Chairman: in the West we do not have oil, unfortunately. We keep looking for it but we cannot find it! However, we do have a Dumbartonshire initiative. The Dumbartonshire Local Enterprise Company has been active in attracting the biomedically-based universities in Scotland to invest in a kind of biomedical science park where we will exploit commercially applicable work in the field of biomedical products, including pharmaceuticals. Just to pick up on the point that I thoroughly agree with Principal MacFarlane about, ie, developing on site on the university a mixture of academic and industry: the Centre for Power Engineering in the electrical engineering department at Strathclyde has brought together Scottish Power, National Grid and all the major players in the power industry in Britain and is seen as the centre for Britain and that has been developed with these industries and with good support from the local Glasgow Development Agency, so there are some highlights I think that illustrate how things can be done.

Chairman

551. I think you have given us very helpful examples of regional strengths where you are linking with regional industries and you have mentioned brewing, the oil industry, and many others. We have heard on a number of occasions how inward investment very often from multinational co-operations after all can go where they want and have no particular loyalty to any region or indeed any country. They will be attracted, will they not, by the quality of the research, by the quality of the teaching—if that is what they are interested in—and, indeed, by the relevance of this work to the industries, particularly those which are closely related to the industrial sector? I wonder if you would like to comment on to what extent you are able to work with Scottish industry or United Kingdom industry in order to test the relevance of these programmes? It is very much a theme, is it not, of the White Paper from the Office of Science and Technology that industry is encouraged to collaborate with academia in determining research priorities? I wonder if you would like to comment on to what extent you perceive a need to strengthen these links or whether that problem has been resolved?

(*Professor MacFarlane*) We like to think that we have a very large fraction of our research and development work directly coupled into industry. It is an absolute commitment of ours. What is necessary, I think, for the future is to build larger, stronger units. You have to recognise that the only development which will stand up has to be looked at in an international context and that means building a number of very large and very strong units and that in my view is what is particularly missing. There is another thing which is actually interesting and that is that inward investment requires a steadily increasing capability to train the workforce and I believe that universities have been—how can I put it—too concerned with higher education and not enough concerned with general training. I think that universities, particularly universities like the one I am involved in, will have to get more involved in developing very sophisticated training programmes for the whole workforce, not just the managerial top class of the workforce.

(*Professor Arbuthnott*) Perhaps I could pick up that leash. Strathclyde and Heriot Watt share to a large extent the mission of the appliance of science, the applicability of the research that we do and at the same time I think that no major industrial partners are going to take us seriously, my Lord Chairman, unless, as you have said, they regard the teaching that we are doing and the education programmes that we are conducting within the university as being of a very high standard. I think if you look across the board at the performance of the Scottish universities in the research assessment exercise you will find that there are some really very outstanding performances there. We are very proud of that. That has attracted an increasing interest from potential industrial partners in that way and you will find that one of the ways we ensure that these contacts are continued is by visiting professorships and by visiting lectureships which are awarded to distinguished members from industry. I would like to add one slightly different dimension: one of the impediments I think to this kind of work is the rather rigid departmental or faculty structure that you can find in a university. What we have done in Strathclyde to get round that is to form a number of institutes. To give you two examples, one is the Strathclyde Institute for Drug Research, another is the Strathclyde Smart Structures Institute. These are not physical entities, they are intellectual entities. They contain experts from different disciplines but are very much focused towards the needs of strategic research and applied research which is of pretty direct relevance and applicability to industry. Through these institutes we gain, for instance, the participation of chemists, physiologists, pharmacologists, engineers in the pattern that you need and the flexibility that you need in the modern day. This approach is proving to be a very successful articulation with industry.

Lord Perry of Walton

552. One of the points that comes up over and over is that usually the investment in R&D from overseas companies depends on direct contact between the scientists from the one country and the scientists from the other and it stems from that rather than from institutional endeavours. Is there something that could be done to promote the inter-changeability of staff? I know that it is relatively easy to get staff from the east especially to come to this country, but it is not so easy to get staff to go to the developing countries. Is there anything that we could do to help with that?

(*Professor Arbuthnott*) I think all of our universities promote that as much as we can. It is coming under pressure, as you would expect, from the pressure for universities to make efficiency gains and, therefore, we have less money to make available

[Lord Perry of Walton *contd.*]

for travel and programmes to enable our scientists to go overseas. I think one of the great advantages of the external involvement and international involvement in science in Scottish universities is that, for instance, in the EU to be successful in the EU you have to have a consortium and that consortium has to involve not only your university and at least one university in a European country but also at least one and possibly two and even three companies. When this consortium begins to work, the interchange of the sort that you wish to see has to happen for the programme to be successful. I would like to see more initiative taken in Britain to promote that consortium approach outside of Europe and particularly in the Far East. The mechanism we would have to talk about.

Lord Butterfield

553. My Lord Chairman, my question is rather different and a personal one, but I am very intrigued to realise how much linkage you have as universities with industry and I am intrigued about the efforts to get down to training top men on the shop floor or on the platform in the North Sea. I wondered if whether to some extent your Chancellors—or whatever you call your colleagues at that sort of level—have been helping you in breaking down the barriers that so often exist within the university faculty structure about industry and us. We have been very lucky at Cambridge in that Prince Philip has been returning time and time again pushing the question of links with industry and the university and I believe he has had a seminal effect in some departments. I just wondered whether, for example, your Chancellor.

(*Professor Arbuthnott*) Lord Tombs.

554. Again, I am wondering whether those kinds of men, the Heads of your universities, are helping this industrial relationship?

(*Professor Arbuthnott*) I would answer that briefly very positively, my Lord Chairman. My Chancellor, Lord Tombs, who has just retired as Chairman of Rolls Royce, assists me and the university very much and we have a programme—I will not go into details—where we meet with chief executives and individuals and research directors of the major companies. We do that in a series of corporate visits to the university and also outside the university. Lord Tombs attends three quarters of these meetings and without his help the interchange would not be as great.

555. Do you think that is facilitating your links overseas as well? Does contact with, let us say, Rolls Royce mean that you get contacts with American aircraft companies or whatever, or is that a very small spin-off of these influences?

(*Professor Arbuthnott*) Most of the major companies that we deal with are multinational companies anyway so that, for instance, with Shell, with BP, with Boeing; contracts with all of these were enhanced by Lord Tombs' experience of an international dimension.

(*Dr Kennedy*) I would like to say in terms of new universities that the link with industry has been paramount from the very inception. My own institution since it was formed 100 years ago—it was formed as an industrial university—its links have been almost entirely with industry. It is because of that that I suppose we got the Chancellor that we did who came from industry, Sir Bob Reid, Chairman of British Rail, formerly with Shell Expo.

(*Professor MacFarlane*) If I could make one point which is quite important. It is very difficult to know what to do about it. When the universities expanded, into many disciplines came and stayed young people who have no industrial experience whatsoever and one of the worrying things about, for example, engineering departments is there are large numbers of people in them who have never worked in industry. That is a fundamental weakness. It is not a weakness which arises from lack of enthusiasm or lack of effort. It is lack of comprehension. Unless you have worked in industry you simply do not know what industry is all about. I hope that as the universities settle down departments which engage in certain kinds of activity will make a real effort to only recruit people who have got significant industrial experience. I would say that would be the most single useful thing which you could do to improve industrial relevance of the work that we do. The second point I could make is a fairly minor one but relevant. We do work with the Boeing aircraft company. It is to do with lasers and they have come to us simply because we are very good at work on lasers. These large companies just look out for the best place regardless and that brings me back to what I said before, we have to build stronger units because there is no way you can stay at the international leading edge unless you have strong units. This I think is a role that the Scottish Higher Education Funding Council might be able to play. It will not be popular and it will be very difficult, but I think there should be a conscious effort to significantly build up one or two absolutely world class centres of research excellence.

Chairman

556. I wonder if I could pursue that point. We have talked on a number of occasions of the need to bring the various institutions in Scotland—be they research institutions in the Aberdeen area or the universities—altogether either in a regional basis or an industrial basis or a discipline basis. Perhaps you could elaborate further as to what extent you think the Funding Council should be the catalyst for this? Perhaps it brings us on to a subject which we touched on earlier, that possibly with the scrutiny exercise and the possibility that the mechanisms for operating the Government research establishments might change, that there might be another opportunity to re-organise administrative machinery so that you could bring this critical mass together.

(*Professor Irvine*) I hope it is not left to the Funding Councils alone. I think the White Paper and the OST are a missed opportunity because most of the spending departments decided they did not want to have anything to do with it. The vast bulk of expenditure will not come through the OST. It will be through the Department of Trade and Industry, the

[Chairman *contd.*]

Ministry of Defence—or that is how it would appear to us. It seems to me that they have not drawn all the strands together and basically it is a redistribution of the moneys that were previously Research Council moneys basically and, therefore, if it is seen as a funding council it will be a minority of the total funds that are spent that we will be talking about and, therefore, I do not think it will actually generate anything new. I think the big problem—and I do not know what you do to get over this hurdle—is to overcome the departmental boundaries in Government and you can persuade the Department of Trade and Industry and the equivalent Ministers in Scotland, the environment, the defence if that is relevant, agricultural, to support a research base communally and not duplicate effort and to work closely with education. I could give you 101 examples of where the Home and Health Department has an initiative. The Education Department has gone in a separate way. For example, the total spend in medicine is going to be crippled in the coming years, I believe, by the fact that the driving force of the health service provision is moving hospitals and so on. London is the most notable example, but we can point to examples in Glasgow and Edinburgh, where if the medical schools are to be maintained as research centres closely coupled to the clinical disciplines and the delivery of health care there is going to be knock-on costs for the movement of medical schools which is far in excess of any capital expenditure that is currently available in the education sector. I would not look to the Higher Education Funding Council alone to do this. It should be a component of it, but I think it really does mean bringing other departments of Government into the picture.

(*Professor Arbuthnott*) I would agree with most of that, my Lord Chairman. Just to take up the point you made about the scrutiny study: one example in the west of Scotland is we have the Hannah Research Institute. Most recently the University of Glasgow and the Scottish Agricultural College, the Hannah Research Institute along with ourselves have formed a consortium where we are talking very actively about bringing together the real areas of expertise, centres of emphasis, within the area of food research in the west of Scotland which we hope would actually compliment well and network with that in the north-east. That is something where I think we are looking for some guidance and help from this efficiency survey that is being done. I would also like to take up a point that has been made by Principal Irvine and that is the funding council really is operating a formula-based funding mechanism. That really drives you down into smaller and smaller units of money and the accountability for the expenditure will be far smaller and smaller units of money. The universities realise—and the results of the research assessment exercise underline it—that we have good very high quality international research. The funding mechanisms that presently exist do not foster co-operation, they foster competition. Therefore, for institutions to work together we have to set aside the competition that drives our basic economy. That is actually quite a difficult double act to perform. We are trying our best. The point that Professor Irvine made that I would like to follow up is that I think in setting the future strategy the Scottish Office should be in a closer dialogue with the educational institutions about the future shape of what we want to achieve, and not simply allowing institutional strategies to be driven by the operation of what is becoming a byzantine formulaic system.

(*Professor Irvine*) I would not be in favour of a central planning authority for the evolution of the sector. I think that would be a disaster. I would rather see a system which rewarded a system which was diverse, is diverse, and I think we would impoverish the total provision if we reduced that diversity. I think the funding council is in danger of doing that. If you have a single funding methodology all the institutions feel constrained to move in the same direction and that is a worry that I have. I would want the capacity to maintain the diversity but to have some kind of reward mechanism that the institutions kept the benefits of the co-operation and that therefore they had a positive incentive to work together. I would rather have a carrot than a stick.

(*Dr Kennedy*) I agree with Maxwell about the worry of any centralised control. I certainly agree very powerfully. I think that any partnerships or consortia should be of free partners and not ones that are being forced into it. The other thing which to me is very important certainly from my own institutional point of view is that I think there are a lot of very small to medium-sized enterprises that do not really know too much about higher education, do not know too much about using graduates and there are different sorts of ecological niches that exist. I certainly see the role of institutions like my own as going out and helping particularly the small to medium-sized enterprises rather than joining with large multinational companies. We are now talking in small numbers of thousands but it could be very important to building up the economic base of Britain in these small to medium-sized companies and I do not think that should be forgotten when considering this. It is very easy to be attracted by the balances and forget that it is the pennies rather than the pounds.

Lord Butterfield

557. I was very intrigued to hear about the potential in Scotland for work on optoelectronics and I wanted to mention that I and some others are involved with a research foundation in Hong Kong which can give grants for research which is linked to a Hong Kong institution. In Hong Kong the Vice Chancellor of the Chinese University is reguarded as a king-pin in optoelectronics. At a place where at the moment there is quite an amount of money for overseas investment in research orientated things, it just struck me that maybe I ought to try and act as an enzyme to get some Scottish workers working with the Chinese University to use some of that Hong Kong money for your research laboratories and hopefully attract some investment subsequently because I believe very strongly that it is by this sort of step-by-step approach that you can get things which are small growing large.

(*Professor Irvine*) I think you will find that we have all visited the Chinese in the past few months.

[Lord Butterfield *contd.*]

558. Did they offer the possibility of collaborative research?

(*Professor Irvine*) I think we are all in discussions with all the Hong Kong universities. We just wish we had a jockey club in Aberdeen that was as healthy as the Hong Kong club!

Chairman

559. Before we conclude this session this morning, could I just ask, bearing in mind the questions that we did pose, whether you feel there are particular areas that you were hoping we would address which we have missed?

(*Professor Irvine*) It is a vast area. I think you have done well.

Lord Butterfield

560. I would like to congratulate the Principal of Strathclyde on his tie!

(*Professor Arbuthnott*) I thought that was rather appropriate for this morning.

Chairman] I think that does bring us to a conclusion. Could I thank all four of you for your patience in answering our questions and in helping us in our deliberations. It is a large subject, but it is one I think which could prove of great interest to us all in the long term and if we can make a contribution to helping all parties—and that is not just the universities but the inward investors as well—then we would like to do so. Thank you very much for your help.

Memorandum from the University of Strathclyde

Q.1 The prime source of international investment in science at the University is through the funding of research by grants and contracts.

Taking into account research projects which have commenced since 1 January 1991, the total value of grants and contracts to date has been £15,282,000, of which £3,236,000 were research contracts from the private sector, £672,000 were grants and contracts from national governments, and £11,374,000 were grants and contracts from other public sector bodies including the European Union.

By far the largest investor was the European Union which sponsored 136 projects having a total value of £11,374,000.

The largest national investors were the USA (22 projects: £1,381,000), Germany (8 projects: £1,097,000), and France (10 projects: £783,000). These figures are detailed in Appendix 1.

The overseas investment in the University's research amounts to approximately 27.5 per cent of the value of all research grants and contracts received during the same period.

Although it cannot be regarded as an investment in science, there is a closely related area of income earned from the licensing of research results and at the University of Strathclyde a significant royalty income is earned from international or overseas licensees.

For the period from 1 January 1991, the University earned £8,426,600 (Appendix 2) from overseas licensees (average exchange rates). In addition a sum of £1,916,000 was earned from UK licensees as royalties from their overseas sales.

Q.2 The factors influencing potential overseas investors in UK science are several. For both public and private sector the most important factors are the quality and reputation of the University's science base. An international reputation is built up by the publication of research results and the willingness of academic staff to travel and to participate in international conferences and similar fora.

The private sector is additionally attracted to the University by its focused marketing of its research capabilities and its intellectual property rights. The University has a reputation for being business-like in its dealings with industry and its approach to intellectual property is attractive to companies who wish to feel that their research contracts and subsequent results are in safe hands.

Q.3 The benefits are significant. The funding of research by overseas sources helps to maintain the University of Strathclyde as a research university having a high national and international reputation.

This in turn helps to attract academic staff and students of high calibre to the University from both home and abroad.

Income from licensed intellectual property is particularly valuable in that it is uncommitted income which can be used by the University without constraint.

The presence of Universities such as Strathclyde in Scotland helps to attract companies wishing to locate in Scotland.

The broadening of the University's science base due to overseas investment increases the opportunity for UK companies to benefit from that resource. The University works hard to retain ownership of intellectual property in addition to the inevitable strengthening of its know-how and its skills base.

It is important that the University's staff are involved in international research and the exploitation of its results; it broadens their experience and this in turn is passed onto their students.

The University has placed emphasis on the forming of multidisciplinary research teams which can span the traditional strengths of perhaps several departments. The availability of complete and coherent research institutes which are professionally managed is attractive to overseas investors. Such institutes are capable of charging high prices for their services but nevertheless represent excellent value for money for overseas clients who wish to invest in an area of science for a limited number of years.

The University has achieved considerable success with the European Union—for two main reasons. Firstly because the University has specialised in the area of strategic research and is therefore well attuned to the type of research project which the EU wishes to support, and secondly because since 1984 the University itself invested in full-time staff both to promote the EU's interest in the University and to support academic staff bidding for EU funding. The University recognised the need to meet and work with the EU officials in order to achieve success.

The same approach is now being adopted in relation to the other sources of international research and consultancy funding such as the World Bank, the United Nations, etc.

Q.4 The contract/grant values awarded by overseas investors are given in the answer to question 1 above.

When dealing with research contracts from overseas companies the University will normally charge a price which covers the full economic cost of the research.

The EU research grants continue to create a significant financial problem for the University. The University is paid in accordance with the EU's "100 per cent marginal cost" formula which provides a recovery of indirect costs limited to 20 per cent applied to most of the direct costs. Translated into a rate applied to labour costs the overhead rate typically lies between 20 per cent and 30 per cent depending on the construction of a project's direct costs. These figures are less than the funding provided by the UK Research Councils, and require the University to provide support for EU projects. We are told that the UK Government is one of only two Governments in the EU not to provide their universities with some form of financial support to assist with their EU research programmes. The University regards EU strategic research as an important make-weight for its Research Council funding.

Q.5 Policy Implications.

Encourage UK universities to engage more fully in EU research programmes by providing a modest level of financial support, thereby putting UK universities on more level terms with their other European counterparts.

Appendix 1

May 1994

Summary of International Research Contracts in Science and Engineering since 1991

Country	*Private*		*Public*		*Government*		*Total*	
	No.	*Value*	*No.*	*Value*	*No.*	*Value*	*No.*	*Value (£)*
Belgium	3	272,000	0	0	0	0	3	272,000
Canada	0	0	1	1,000	0	0	1	1,000
EU	0	0	102	8,300,000	0	0	102	8,300,000
(EU training and education)	0	0	(34)	(2,600,000)	0	0	(34)	(2,600,000)
France	9	725,000	0	0	1	58,000	10	783,000
Germany	8	1,097,000	0	0	0	0	8	1,097,000
Holland	2	15,000	1	14,000	0	0	3	29,000
Ireland	2	23,000	0	0	0	0	2	23,000
Italy	2	74,000	0	0	0	0	2	74,000
Japan	4	319,000	0	0	0	0	4	319,000
Kenya	1	13,000	0	0	0	0	1	13,000
Malaysia	0	0	0	0	1	165,000	1	165,000
Sweden	1	1,000	1	9,500	0	0	2	10,500
Switzerland	6	103,000	0	0	0	0	6	103,000
USA	12	594,000	5	338,000	5	449,000	22	1,381,000
NATO	0	0	2	5,000	0	0	2	5,000
UNIDO	0	0	2	26,000	0	0	2	26,000
WHO	0	0	3	80,000	0	0	3	80,000
TOTAL	**50**	**3,236,000**	**117**	**8,773,500**	**7**	**672,000**	**174**	**12,681,500**
Including EU Training and Education	**50**	**3,236,000**	**151**	**11,373,500**	**7**	**672,000**	**208**	**15,281,500**

Appendix 2

May 1994

International Income from Licensed Intellectual Property since 1991

Country	*Licensee*	*Value (£)*
Austria	American Cyanamid	3,000
Belgium	American Cyanamid	3,000
Europe (excluding UK)	Wellcome Foundation Ltd	2,000,000
France	American Cyanamid	20,000
Greece	American Cyanamid	1,000
Ireland	Howmedica	94,000
Italy	American Cyanamid	173,000
USA	American Cyanamid	120,000
USA	American Propylaea	6,700
USA	Burroughs Wellcome Co	6,000,000
USA	Dagan	2,500
USA	Johnson & Johnson	3,400
TOTAL:		**8,426,600**

Further memorandum from the University of Strathclyde

RESEARCH GRANTS AND CONTRACTS

1. *What proportion of income do research grants and contracts from EU/Overseas represent?*

EU Sources	1,722,000	11.9 per cent
Elsewhere	310,000	1.9 per cent

2. *Has any of the universities represented secured long-term support from overseas, comparable for example with the partnership between Edinburgh and Fujisawa? If so, what are the benefits of the arrangement to the university and to the overseas partner?*

The University of Strathclyde does not have long-term overseas support akin to the partnership between Edinburgh and Fujisawa.

3. *Does any of the universities represented put a higher price on overseas contracts than on contracts for UK (or EU) firms, to reflect the British (or EU) taxpayer's support for the Science Base?*

If the research contract from overseas is initiated by the sponsor then the University of Strathclyde will charge a full commercial price. If the University is seeking support for research that it wishes to carry out and is offered support by an overseas company then the price charged may be less than the full commercial price but the University would retain ownership of the foreground intellectual property resulting from the project.

4. *When international interests place research contracts with your universities, do they gain access to background IPR "on the cheap"?*

The University has a policy of always identifying its background IPR, protecting it, and licensing it on commercial terms to those who wish to use it. Overseas research sponsors do not gain access to our background IPR "on the cheap". The University is careful to differentiate between background and foreground IPR and regards research contracts with corporate partners as an opportunity to license background IPR.

5. *What other policy issues arise from research funding from overseas?*

The University regards itself as having an international research business with some of its research areas being recognised internationally as centres of excellence. The UK gains both financially and intellectually from the fact that its universities obtain research funding from overseas; this dimension is of benefit to students who are exposed to staff who are engaged in international transactions. Therefore, the policy issues which arise (to discriminate between UK and overseas research sponsorship) are few in number.

6. *What funds have your universities attracted from the EU Framework Programme, Social Fund and Regional Development Fund? How have these funds affected your activities? In particular, have they made it easier for you to make links with industrial firms in other EU countries?*

Since beginning to apply for EC (now EU) funding for research, training, and technology transfer activities in 1983, the University has to date earned c.£21 million.

The Framework Programmes in particular have brought a high level of collaborative research of a multidisciplinary quality to the University. The University readily embraced the European opportunity, and now regards it to be a normal, everyday occurrence to work with colleagues in other European countries. These linkages are with both industrial firms and academic institutions and the Framework Programmes have undoubtedly made it easier for us to achieve them.

It is also the case that these Programmes have enabled the University to work more closely with a number of UK companies who themselves have participated in EU projects.

The Social Fund and the Regional Development Fund are intended to strengthen disadvantaged areas recognised by the EU and do not directly foster EU linkages. The Social Fund has enabled the University to engage in specialist training activities which otherwise were unlikely to have been considered. The ERDF has only more recently been accessible to the University sector and at Strathclyde is being used to support new building programmes and its technology transfer activities within the category 2, Strathclyde Region.

7. *Has Scottish Enterprise helped you to win funds from overseas?*

Scottish Enterprise has not helped the University to obtain overseas funding for research to any significant extent.

8. *Which Scottish universities have won the Queen's Award for Export in respect of scientific research, and what for?*

Strathclyde has won a Queen's Award for Industry (Drug Development) and for Export (Distance Learning MBA Programme). It has not won a Queen's Award for Export in respect of scientific research.

9. *What could the Government do to help you to maintain and increase your research income from overseas?*

(i) The EU research funding rate is lower than that provided by the Research Councils; expressed as a percentage of labour costs our recovery of overhead costs is typically in the band 20 per cent to 30 per cent. It would make EU funding much more attractive if the UK Government were to provide "top up" funding as do (reportedly) all other government of EU countries bar one. This would help the University to maintain the current level of EU funding during a period of considerable financial constraint.

(ii) The Government could usefully promote the UK Universities' research strength overseas. Perhaps, in developing countries, it would be beneficial to link postgraduate studentships with longer terms research on topics of relevance to the countries concerned.

OVERSEAS STUDENTS

10. *What is the Scottish population of overseas students, both undergraduate and postgraduate?*

Where is it concentrated, in terms of universities, subjects and sending countries?

See SHEFC Statistics.

NB The EU students included in these statistics are very largely exchange students who are *not* additional to Home student numbers.

11. *Apart from the money, how do you benefit from taking overseas students? Are they displacing potential Scottish students? Are you "feeding the competition" as they go home?*

The non-financial benefits of overseas students are as follows.

(i) They enrich the university environment, providing a variety of cultural background which contributes to the learning experience of our students.

(ii) Their presence and success help to enhance the reputation and profile of the University internationally.

(iii) Overseas research students are important in strengthening the research base of the universities. At Strathclyde, for example, 45 per cent of our postgraduate research students are from overseas.

(iv) Home students are *not* displaced. Overseas students involve *additional* income and employment opportunities.

(v) Regarding "feeding the competition", it is perhaps inevitable that over time the developing nations will send fewer students abroad as they acquire the expertise to deliver higher education internally.

However this is a slow process of change. Our current experience is that former students are very helpful in "selling" the university in their home country and therefore in encouraging new generations of students to study in Scotland. In addition, many former students go on to fill important posts and are influential in promoting the UK and the City of Glasgow in their various governmental and industrial positions.

12. *What could be done to maintain and improve Scotland's share of the overseas student "market"?*

Much is being done already, but the initiative tends to be taken by individual institutions. There could be advantage in greater co-operation among institutions to launch overseas missions, particularly to countries which are identified as growing markets for HE. Government help in this area would be welcome and, in terms of the benefit to the Scottish economy, worthwhile. One particular concern of Scottish institutions is that the distinctiveness of Scottish Higher Education tends not to be well understood when UK-wide Higher Education is promoted by the British Council or by Government Departments.

13. *What outcome do you hope for from the Efficiency Scrutiny of Government Research Establishments—particularly in the areas of Agriculture and Fisheries?*

We are looking for a closer liaison with the universities so as to maximise the potential of the Scottish research base. At Strathclyde we have already taken positive steps in this direction, promoting the development of a West of Scotland consortium alongside the University of Glasgow, the Scottish Agricultural College and the Hannah Research Institute.

Letter from the Principal of Heriot-Watt University

Following my oral evidence to your committee this morning at the Royal Society of Edinburgh, I thought that it might be helpful to let you have the detailed statistics which I had prepared for the meeting.

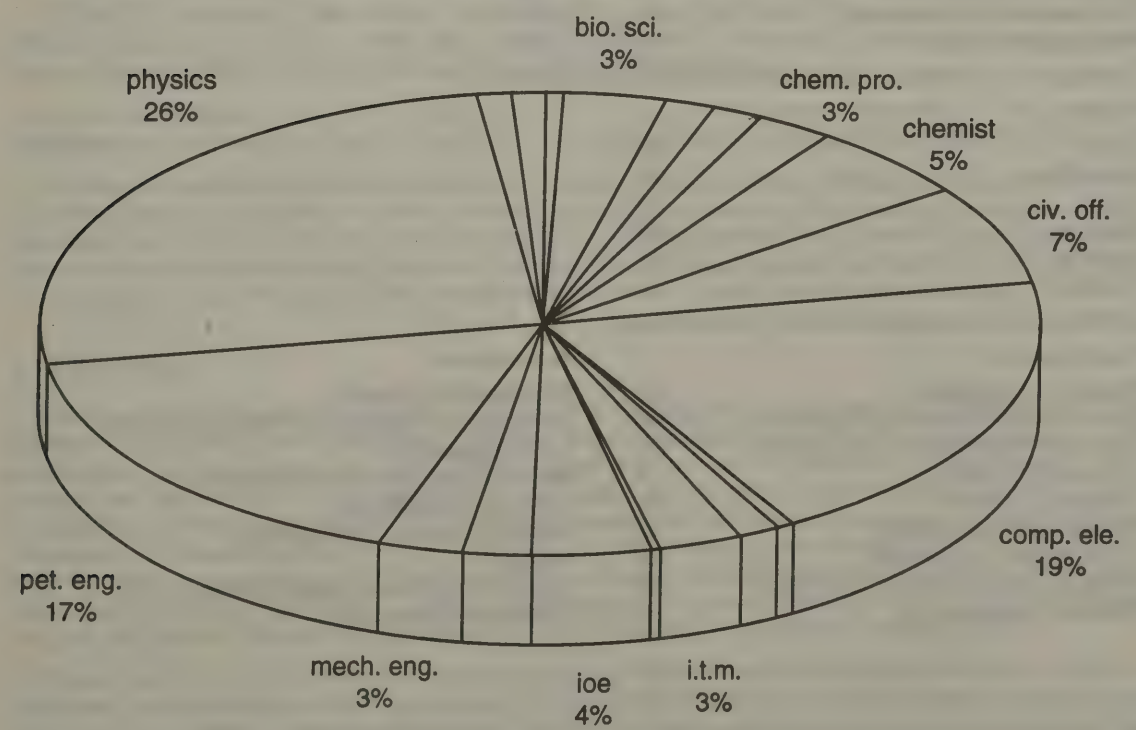
Document A shows how our total research and contract grants for 1992–93 break down.

Document B (*not printed*) lists the various individual grants with the EU grants marked in yellow, and the other overseas grants marked in green. As I said at the interview we get 17.1 per cent of our income under this heading from outside the UK, and 15.2 per cent comes from the EU.

Document C gives details of the composition of our overseas student population.

I trust that this may be of help to you in compiling your report.

New Grant Awards 1st August 1992 to 31st July 1993



Total Grant Awards = £10,241,799

Department	*Value of grants 1992–93*
acc.fin	£3,399
actmath	£80,693
bio.sci	£320,115
buil.eng	£191,871
bus.org	£149,612
chem.pro	£270,030
chemist	£536,384
civ/off	£726,962
comp.ele	£1,983,258
econ	£69,187
hwtu	£135,685
i.t.m.	£269,278
icbl	£9,159
icms	£7,400
ioe	£402,057
math	£241,349
mech.eng	£267,154
pet.eng	£1,740,213
physics	£2,632,653
tv.cent	£106,300
unilink	£99,040
TOTAL	£10,241,799
No. of grants 170	

DOCUMENT C

OVERSEAS STUDENTS AT HWU—1993–94

Total Population:	420	(790)
Undergraduate (full-time):	213	(370)
Undergraduate (part-time):	17	(103)
Undergraduate (off campus):	2	(8)
Postgraduate (full-time):	168	(272)
Postgraduate (part-time):	1	(8)
Postgraduate (off campus):	13	(17)
Postgraduate (staff):	6	(12)

(The figures in brackets include all EC students paying home fees)

Countries	
China	22
Hong Kong	16
Libya	10
Malaysia	70
Norway	114
Singapore	16

of which the following subjects are most popular—

Undergraduate		*Postgraduate*	
Business Organisation	61	Petroleum Engineering	14
Electrical and Electronic Engineering	20	International Banking and Financial Studies	11
Actuarial Mathematics and Statistics	18	Civil Engineering	9
Offshore Engineering	13	Electrical and Electronic Engineering	7
Computer Science	11	Computer Science/HCI	6
Mechanical Engineering	12	Marine Resource Development	5
Accountancy and Finance	10	Physics	4
Building Engineering and Surveying	10	Construction Management/Building	3
Chemical Engineering	4	Offshore Engineering	2

WEDNESDAY 8 JUNE 1994

Present:

Dean of Beswick, L.
Desai, L.
McColl of Dulwich, L.
Nelson of Stafford, L.
Perry of Southwark, B.
Perry of Walton, L.
Porter of Luddenham, L.
Selborne, E.
Walton of Detchant, L. (Chairman)

Memorandum by the Royal Academy of Engineering

Executive Summary

1. The Royal Academy of Engineering welcomes the opportunity to submit evidence on "International Investment in UK Science" to Sub-Committee I of the House of Lords Science and Technology Committee.

2. The difference between the investment policies of UK and overseas companies is noted. Overseas companies invest in basic science of a strategic nature in recognised centres of excellence and appear to embrace long term relationships. UK companies appear more concerned with products further downstream in the development cycle and hence short term investments.

3. A company unable to carry out the research work in-house will contract it to wherever the expertise exists—frequently with known teams. The existence of a world-class team with a track record of producing high quality research and innovative output is an important factor in attracting funds.

4. The ultimate aim of overseas companies investing in research, wherever it may be, is to secure an eventual competitive advantage. Overseas organisations without an existing development or manufacturing base in the UK seek to acquire knowledge at low cost and to recruit staff.

5. Overseas companies without a UK base must expect to pay the full economic cost of research commissioned in the UK and not be subsidised by the UK tax payer.

6. Benefits of overseas investment in UK research include an enrichment of the science base and a strengthening of centres of excellence. Through working in the international domain UK research is able to retain its world-class standard. A strong technology base is essential for a successful manufacturing nation.

7. The UK government must adopt a policy which ensures that more of the material benefits of UK research accrue to the UK. A more entrepreneurial approach is required to research funding so that universities can develop new ideas and spin them off into small companies.

8. Overseas investment is not a solution to lack of UK government investment in this country's infrastructure. It is, however, a way of gearing up a basically sound UK strategy for investment in research.

The Royal Academy of Engineering undertakes the pursuit, encouragement and maintenance of excellence in the whole field of engineering. In order to overcome traditional barriers, the Academy promotes a multi-disciplinary approach to demonstrate the interdependence of different areas of expertise in the effective use of modern technology and engineering. Emphasis is also placed on the importance of well-informed communication between engineers, Government, research establishments, industry, public services and academia.

1. Introduction

The Royal Academy of Engineering is the United Kingdom's independent self-governing body of professional engineers of all disciplines. The Academy's objectives are the pursuit, encouragement and maintenance of excellence in the whole field of engineering in order to promote the advancement of the science, art and practice of engineering for the benefit of the public. By recognising Britain's most distinguished engineers The Academy aims to take advantage of their wealth of engineering knowledge and experience. The interdisciplinary character of The Academy's membership provides a unique breadth of engineering experience with which to further all forms of engineering. This response is a collation of personal views from Fellows of The Royal Academy of Engineering. It cannot reflect the views of all contributing Fellows nor those of The Academy as a whole. It may, however, be regarded as representative.

The comments which follow are not so much concerned with the statistical picture of how much is funded and where, which can be provided by government or the Higher Education Funding Councils, but more with the context in which the inquiry is taking place. The Sub-Committee should consider also obtaining a picture of the collaborative activities of UK universities through making enquiries of various EC and DTI programmes.

Fellows have commented on the difficulty of defining exactly what is meant by an "overseas owned company" since many multi-national companies have substantial assets in the UK. These may take the form of human resources, manufacturing or assembly operations, or a distribution organisation where the UK is used as a point of contact to export to other nations. Also, does the term "investment" include shareholdings, as well as (say) direct funding of research establishments?

High-level academic research must be regarded as a "global business". The major benefit to a university department, the staff, students and UK industry, is that such investment helps to maintain the department in the top rank of scientific/engineering research in the world. The influx of overseas students acts as a significant invisible export when they return to their countries of origin to establish research enterprises and commercial contacts with the UK. Through pursuing links with overseas investors additional insight can be obtained into original research being undertaken elsewhere. The knowledge thus gained may contribute to a technical development in the UK.

Research

It is important to recognise that research, for engineering-based businesses, is not a simple commodity that can be bought in a one-off transaction. Associated with the generation of every research result is a great deal of know-how that is needed, along with the result itself, to exploit the new knowledge. Accessing this know-how requires close links between the research teams and the business units that are the ultimate users of the research results. It is very difficult to form the links after the research has been done and the researchers have moved on to new targets. The contact must be established at the outset. Ideally, a research team will have members of a business unit seconded to it, if only part-time.

The situation may be different for other industrial sectors, eg, pharmaceuticals where the formulation developed in a laboratory is the key piece of intellectual property that is closely related to the final commercial product. Such a research outcome can be handed on easily. But in strategic or applied research in engineering the maxim "technology transfer by people transfer" reflects the importance of know-how. Training programmes may also be needed whereby the research organisation inducts the end-user in the multi-disciplinary skills needed to utilise the new technology.

It follows therefore that good proximity between research organisations and end-users, allowing frequent contact, is very desirable. Stability in the core research team is also needed so that accumulated know-how is not lost. With this perspective it is easy to see why companies have in the past relied, perhaps too heavily, on their in-house corporate research laboratories. They have lived with the not-invented-here syndrome rather than face the challenges of building a sophisticated and enduring relationship with other organisations such as universities. At least companies in the UK are now setting up meaningful relationships with universities—witness Rover's own pioneering Advanced Technology Centre at Warwick University. But the above perspective also demonstrates that trawling around the world for good research ideas is not a simple matter. Before investing overseas, a company does need very clear reasons.

Investment

There are several quite distinct types of investment. Firstly, there are the collaborative international programmes to which the UK contributes as well as receives, eg via the EC, and (to a lesser extent) NATO and reciprocal agreements between academic societies like the Royal Society. Secondly, there are foreign national programmes to which UK teams may apply, eg the USDoE and NSF programmes (interestingly, AEA (a commercial division of the United Kingdom Atomic Energy Authority) can apply to these but not yet the UK Research Councils). Investments which fall into these categories are generally beneficial to the UK but a lot of effort must be put into influencing the choice of topics. In the UK this aspect is not always managed as well as it is by our competitors in France and Germany. The link with exploitation should also be planned out at an early stage in the project definition. Thirdly, there is the support of industrial research laboratories by overseas companies, eg Kobe Steel, Ford, etc. Finally, there can be investment in facilities which may be used internationally with the sole purpose of acquiring and developing a specific area of expertise or process. Examples include Japanese support for certain facilities at UK universities and the basing of equipment at the Rutherford Appleton Laboratory by university teams from other countries. Support which is of much more direct commercial nature can be injurious to the UK's long term interests. Academics who are starved of funds from our own agencies often tend to grab at the chance of relatively little support from overseas if it enables them to employ one or two research assistants and buy some of the latest equipment. They may be prepared to sign away all their IPR for such support.

The figures available[1] suggest that the UK receives a relatively high proportion of its research investment from overseas. One reason is simply that UK science funding has formal barriers to prevent laboratories in one sector applying for funds from another, so that there is an incentive to look at other routes. Another factor is the quality of UK science which, despite growing concerns, is still impressive in many areas. A further factor is that so many UK industries have reduced or eliminated their research laboratories that those who

[1]OECD Science and Technology Indicators Report No 3 (1989)

traditionally placed work in universities are no longer there to do so, and the more industrially-oriented university departments have turned to foreign sponsors.

In addition to universities, investment is made into research carried out by other organisations eg AEA, where the major international links are with the EC as well as collaborations or trade with the nuclear and other industries worldwide. The EC interactions are especially testing, in that there are political limits on the proportion of EC funding that can realistically be won by UK partners, and also that there are frustrations associated with matching funds. A case in point is that some parts of the EC are now seeking firm commitments at the time of application that matching funds will be available. In some cases these funds are properly UK Government funds, and the UK Government position is unhelpful, in that it will not confirm that such funds would be available. There are other word-of-mouth criticisms of UK Government commitment to EEC activities, and the example we give may be just one. In both the nuclear and non-nuclear sectors, a significant part of AEA's commercial income comes from outside the UK. This is earned competitively: cost and quality are major factors. We believe this can lead to further income; however, when it is projects with a strong research and development (as opposed to technical service) component which are funded, there is always an issue of intellectual property. Such issues need care, but have not led to serious compromises at this stage. Since the activities often put UK teams alongside those of the sponsoring nation, their difference in culture can be a beneficial learning experience.

Another point which is thought to be relevant is rather indirect. In Wales, the Welsh Office and the Welsh Development Agency see the Universities (particularly Cardiff and Swansea) as a resource for helping them to attract inward investment from USA, Japan and, more recently, Germany. Significant grants have been received to enhance a few research strengths into Centres of Excellence and then there has been a link with an incoming Company. This has benefited the wider economy, has helped the University and has been spectacularly successful in attracting inward investment to Wales.

Comments from a UK-based international company

The following comments give a concise pen-picture of research investment by a UK-based international company with sales of £1.8 billion. The majority of the sales and assets are outside the UK.

In common with most other UK-based international companies the principal R&D centre is maintained in the UK. The non-UK companies fund the R&D centre by way of royalties and the amount of funding is approximately £10 million a year. In addition, individual companies within the organisation fund projects directly with 70 universities worldwide. The international split of universities funded is 38 in the UK, 20 in mainland Europe and 12 in the USA.

From this perspective, the factors that influence potential investors in science and technology are:

1. The location of the HQ of individual international companies since this type of company tends to support science in its host country.
2. The perception that a particular university/science establishment is a centre of excellence for a required expertise. This perception is not always correct, but is based on reputation and how the science establishment sells itself.
3. The university/science establishment is local to a particular operating company. There is close contact between the parties concerned, frequently based on personal empathy and an ability to see easily the progress being made.

The benefits to the sponsor of research outside internal resources are a fresh and unprejudiced approach to a particular subject. In addition, if the research centre is a centre of excellence, there is the potential for a rapid solution to the problem posed, a vital requirement in any commercial environment. The benefits to the science establishment are an increased body of knowledge which attracts further projects and good post graduate students. Furthermore, the company tends to give more employment offers, at the post graduate level, to universities with which work is sponsored.

From a commercial perspective, industrial/company R&D centres need a source of good engineers and scientists from the country in which they are located. If they are not available the commercial imperatives are such that company R&D centres will migrate to those countries that can provide the trained talent.

Most industrial companies face intense international competition with regard to their product offering. They are open-minded about using any source of knowledge or expertise that will enhance their product. British science at the University level may be able to increase its funding from commercial sponsorship by marketing effectively what it has to offer. It may be interesting to benchmark our position with institutions like MIT in the USA and Aachen in Germany.

Answers to the questions asked by the Sub-Committee:

1. *What is the extent, nature and variety of overseas investment in UK science?*

How does this compare with investment by UK interests in science overseas?

1.1 The Royal Academy of Engineering is only able to make qualitative statements on the extent of overseas investment in UK science. Quantitative figures should be available from either Government statistics or the Higher Education Funding Councils, to whom annual returns are made.

1.2 A commonly held view is that overseas companies employ an investment policy which differs from that of UK companies. Overseas companies invest in basic science of a strategic nature in recognised centres of excellence and appear to embrace long term relationships. UK companies appear more concerned with products further downstream in the development cycle and hence short term investments. This reflects the general perception that the City expects UK companies to produce a return on investments on a much shorter timescale than overseas financial institutions expect of their national companies. Consequently, a number of research institutions are increasingly reliant on investment from outside the UK for research funding in engineering. An additional disadvantage to the future prosperity of the UK is that frequently the technical development of products arising from the research into the basic science returns to the overseas country for exploitation and national benefit. Examples exist of overseas companies attempting to tap into existing UK science activities when there is no natural outlet for that science in the UK.

1.3 The majority of funds for research originate from UK sources although, in recent years, the proportion funded from various EC programmes has been increasing rapidly. There is also a significant investment mostly from the USA and Japan. Within the offshore oil and gas industry "Joint Industry Projects" involving Norwegian, French and US oil companies constitute a substantial research activity which is well directed and of high quality. This may be regarded as a model for industrial R&D. However, doubts have been expressed concerning attempts to coerce foreign operators into either placing R&D contracts or joining group sponsored projects as a mark of earnest participation in this country.

1.4 At the end of the day, if a company is unable to carry out the research work in-house it will contract it to wherever the relevant expertise exists—frequently with known teams. UK companies do fund research activities overseas. An example exists in certain semiconductor chip developments where an investment has been made in the USA following the loss of the UK leading position as the result of:

— a lack of government understanding and willingness to take a long-term vision on the semiconductor industry; and

— a lack of investment by a major UK player, again motivated by the way in which it operated in response to the City and risk-averse strategies.

2. *What factors influence potential investors in deciding whether to come to the UK for science, or to go elsewhere? (whether elsewhere in the EC or elsewhere in the world)*

2.1 One of the most important factors in attracting funds for research is the existence of a world class team with a track record of producing high quality research and innovative output as measured by patents, publications and citations. Such a team should also offer a very focused attention to the company's business needs. The UK has an advantageous position with its long established reputation, particularly at our older universities, but also with the diligence of some of the newer universities in attracting overseas students and thereby raising their profile as potential contractors for research. The motivation for overseas investors may also include: an aim to become self-sufficient in education, training and research; technology transfer to acquire practical skills and knowledge relevant to their indigenous industries; improved English language skills; and the kudos of a UK degree from a university with an international reputation.

2.2 In the past there was an advantage of lower cost but this is less of a factor today as more realistic overheads are charged. Nevertheless, UK university science has a low cost-base compared with the USA as typical overheads at 40 per cent are low and, often, research students are funded via research councils or other sources.

2.3 It must not be forgotten that the ultimate aim of overseas companies investing in research, wherever it may be, is to secure an eventual competitive advantage. This is most likely to be the motive when research groups are such leaders in their field that companies flock to them from abroad, whatever the distance and difficulty. Overseas organisations without an existing development or manufacturing base in the UK invest in UK research groups primarily for a mixture of two reasons: to see what knowledge/potential advantage can be acquired at a low cost; and to recruit staff. An excellent research reputation, which attracts investors, coupled with a perceived underfunding by university staff results in a commercial sponsor, from any nation, receiving a very good deal which probably does not reflect the true economic cost of the work. Our education system produces graduates and post-doctorates who are relatively young and therefore relatively inexpensive to employ.

2.4 In the offshore oil industry an additional factor may be a requirement by the UK government for a disclosure of the R&D contracted in the UK when applying for the next round of oil field licences.

3. *What are the benefits to the parties concerned, and the wider UK economy? (both short and long-term, both tangible and intangible—including such matters as training, employment, intellectual property, access to and exploitation of results, one form of investment attracting another)*

3.1 Many of the benefits are self-evident and include an enrichment of the science base, a strengthening of centres of excellence and opportunites for reseach workers to progress to other posts. For a university, in addition to the financial aspect, the traditional and perhaps still the most important benefit is the direct kudos to the researchers, their department and the university. Staff and students benefit from the intellectual challenges; there may be direct benefit in the exploitation of intellectual property rights; and the local economy may benefit from resources spent locally or through enabling a local research-based industry to be established.

3.2 Another benefit of a research project being carried out in the international domain is that it ensures that the work is of world class. The added value of bringing together compatible researchers from different countries can be very substantial. A particularly successful scheme is the Collaborative Research Awards, funded by NATO for NATO member countries, with the objective of facilitating communication between such groups through a modest contribution to the overall research budget.

3.3 There is very little benefit to the wider UK economy from such investments unless all academics concerned also have clear links with UK industry so that work funded by overseas companies can pass into the technological development stage in the UK. A loss of intellectual property rights to an overseas investor and hence a UK competitor is certainly a loss to the UK economy.

3.4 For the UK to be successful as a manufacturing nation it must have a strong technology base. This is enhanced by overseas investment in UK universities encouraging and maintaining world-class research teams. The ability of our education and industry sectors to renew these teams also serves the competitive industrial activity in this country and, through UK multi-national industrial ownership, that of other countries.

3.5 Whilst the intellectual property rights (IPR) resulting from research programmes will be the property of the investing company the background knowledge and many of the people involved in the programmes will remain in the UK and be available to UK industry. Universities may over-value IPR by not fully appreciating the costs associated with taking the results of the research to the market place and hence the loss of IPR to the industrial funder of a programme is of less concern. Of greater concern is the situation where the UK has established close ties and set up programmes under conditions of particular commercial trust. Whereas the integrity of the academic collaborators is not in doubt, a potential exists for the leakage of knowledge of methods and products through the presence of overseas students (sometimes from the companies of potential competitors). This concern for the security of a company's own technology base within the naturally more open environment of a university may ultimately limit the scope of joint activities or may require the introduction of security-locked "enclaves".

4. *What is the level of expenditure by investors, and are there costs (direct, indirect or intangible) to the hosts?*

4.1 The level of expenditure by investors cannot be extrapolated from the information provided by a small number of universities. The Statement of Accounts for each establishment should identify EC and other overseas grants. Alternatively, as stated in response to question 1, the figures should be available from the Higher Education Funding Council.

4.2 The "discounting" of research costs as universities compete for industrial contracts has been mentioned in response to question 2. If the company concerned is not operating in the UK, not paying UK tax or providing employment, then any university which is charging at less than full economic cost is using UK funds to subsidise the overseas operation. An overseas company operating in the UK, which may have been attracted here through research contacts, contributes to the UK economy and its use of the national resources is acceptable.

5. *What are the policy implications for the British government and British science?*

5.1 Science and technology research, and their results, are already international and the policy which must be adopted by the British government is to ensure that more of the material benefits accrue to the UK. Whilst this is the theme of the White Paper "Realising our Potential", it remains to be seen whether the policy will be successful. A much more entrepreneurial approach is required to research funding so that universities can develop new ideas and spin them off into small companies on Science Parks.

5.2 As far as national policy implications are concerned it is clear that our principal competitors, the USA, Japan, Germany and France, view their industrial viability in strongly nationalistic terms and equate industrial success with national wealth. We cannot opt out of that but, given the background of a decline that

seems to be hard to stop, we do need to consider industrial international alliances, but only if they are based on powerful equity positions.

The EC programmes could be used to form such alliances but the benefit is realised only if, after the work is done, the alliances stay in place to exploit the results. Concerning industrial policy, the government should aim to assist a viable UK position based on decisions in the wider economy that take into account industry's capabilities. As an example, consider railway equipment manufacturing where the UK once held a significant position. In the absence of a transport policy the railways have declined, their equipment requirement reduced, the UK competition for the TGV cancelled, the railway workshops taken over by ASEA-ABB, we cease to export; we even import.

5.3 The British government should seek to be far more selective in its support of British science and technology since there are many large scale areas of science in which the only conceivable application is via an overseas company. Successful companies can arise from new science but these are in a very considerable minority. The company which will be successful in exploiting science is the one which has a pre-existing manufacturing and marketing mechanism to get a product into the market place. Government investment in science for which there is no existing, and substantial, UK outlet is an investment supporting another country's economy.

5.4 The UK must maintain and support Centres of Excellence. Even-handedness leads to mediocrity. The existence of international investment in UK science recognises these Centres of Excellence and thus supports a larger science base at the leading edge of technology than the UK could otherwise afford. Through maximising the money invested in research, external funds are attracted which is of benefit to the national economy and balance of payments. It is believed that some tax benefits should exist to encourage sponsors of research in the UK although value for money must feature prominently in the discussion. What is of concern and potentially damaging is the loss of young, bright overseas postgraduates who form a high percentage of postgradute students. This is a reflection on the weak funding of UK postgraduate students by government and industry. The potential for transferring intellectual property to overseas economies in competition with the UK is recognised. On the other hand, international investment in UK science is just as necessary to support quality research as international investment in quality UK companies.

5.5 The UK government investment in UK universities and manufacturing industry should match that of the other manufacturing nations. Overseas investment is not a solution to lack of UK government investment in this country's infrastructure. It is, however, a way of gearing up a basically sound UK strategy for investment in research. One possible infrastructure model has all Basic Research funded through the HEFCs and all Applied Research funded jointly by the Research Councils and UK industry, or by overseas investors at premium rates reflecting their benefit from the infrastructure. UK companies should also have the same opportunity to invest in overseas universities.

5.6 Other policy matters worthy of consideration include:

- recovery of the full economic cost of research, in a group funded largely by UK public money, from an overseas customer without development or manufacturing facilities in the UK;
- agencies concerned with inward investment should satisfy themselves that they have proper intelligence of the research links in those areas where the research could be a precursor to an overseas company establishing business here;
- companies operating in the UK have no excuse for not taking maximum advantage of the UK research base which is relatively low cost but well-educated and comprehensive. Foreign competitors ought to find it very difficult to identify virgin territory in which to pick up strategic and applied research on the cheap;
- promoting a study of those areas where an overseas company (ie, one with no other operations in the UK) is investing in UK science and technology and what it tells us about the UK industrial base;
- foreign take-overs of UK companies should be conditional on a disclosure of the amount and a list of projects supported in UK R&D. This should also apply to offset agreements (the AWAC offset agreement with Boeing after the Nimrod fiasco was clearly unfulfilled, not monitored, and not checked);
- experience with establishing internationally funded "Joint Industry Projects" in the offshore oil and gas industry have revealed them to be very expensive. Consideration should be given to allocating some of the DTI/EPSRC grants to setting up international research clubs. It is not thought practical for public funds to support one-to-one R&D arrangements.

5.7 Except in rare and extreme political situations there should be a "free-trade" in scientific funding with no attempt to block the funding of research by industrial sources that are seen by UK industry to be competing in their own spheres of endeavour. Such collaboration provides the UK with the only true measure of its own competitiveness. In the case of Europe, there is increasingly a need to have national programmes that sustain an adequate "well-found" capability as a prerequisite to securing major participation in EC funded projects. The UK cannot, therefore, rely entirely on EC funding for any research area.

5.8 It is thought that the idea of an industry-led research initiative for funding engineering research at UK universities with government money does not bode well for universities. There is a need to facilitate a partnership between universities and industry, not a situation where industry will be in the driving seat as to what engineering research should be done. It is feared that a heavy influence from large UK industry on university research will, in general, spell disaster due to the lack of drive and initiative from large companies.

Examination of witnesses

PROFESSOR BRIAN CLARKSON, Principal, University of Swansea, and PROFESSOR COLIN BESANT, Professor of Computer Aided Manufacture, Imperial College of Science, Technology and Medicine, Fellows of the Royal Academy of Engineering, were called in and examined.

Chairman

561. May I say first of all a sincere thank you to you for coming and also for the written evidence that you have provided for us which the Committee has found extremely helpful.

(*Professor Clarkson*) Thank you, my Lord Chairman. We would certainly like to thank the enquiry for this opportunity to present oral evidence on behalf of the Royal Academy of Engineering. The written statement of course presents a composite view of academics and industrialists and we here today can just deal with parts of that directly, but if there are other areas which the Committee would like to have more information on, then the Royal Academy will provide additional written evidence for you on those points. For myself, I should introduce myself. I am head of one of the medium-sized universities, which has a significant engineering faculty. Myself, I am an aeronautical engineer by profession and my colleague, Professor Colin Besant, will introduce himself.

(*Professor Besant*) Good morning, my Lord Chairman. My name is Colin Besant from the Imperial College of Science, Technology and Medicine. I am responsible for quite a large section that is working in the field of design to manufacture, so the manufacturing industry is of considerable interest to myself. I think there is one thing I would just like to add to the opening statement with respect to the Royal Academy of Engineering in the knowledge that you are very keen on the relationship of the United Kingdom with overseas countries. The Royal Academy of course is developing strong links with comparable organisations in various countries around the world: I have been involved in establishing links with the Korean equivalent of the Royal Academy of Engineering and other countries, so that is one very strong mechanism for linking engineers at a very high level around the world. Then of course the Royal Academy does have other schemes for linking engineers in this country to other countries, like the Engineers to Japan scheme.

562. Thank you very much, and may I just add that you have been very assiduous, as indeed has the Engineering Council, in providing information in detail to us as Members of the parent Select Committee on Science and Technology, and we regularly receive documentation from you and press releases which have been extremely helpful. Now, of course we know the terms of reference and the nature of your Academy. Perhaps you might just clarify for us in the beginning, if you would, the inter-relationship between your activities and those of the Engineering Council.

(*Professor Clarkson*) The Royal Academy of course is the senior academy for professional engineers, those engineers who have reached an eminence in the profession, whereas the Engineering Council is the body which primarily looks after the professional training of all engineers.

563. Yes, thank you, so that is in a sense the regulatory authority and you are more the academic body which is responsible for, as you say, the activities you describe in your document.

(*Professor Clarkson*) Yes.

564. Now, can you let us have some details about the activities of the Academy, other than what Professor Besant has just told us, which encourage overseas interest in British engineering and can you give us examples of many recent successes in attracting contracts or investment to United Kingdom universities or other bodies?

(*Professor Clarkson*) I think the main aim of the Royal Academy of course is to promote United Kingdom engineering excellence. It does not seek directly to encourage inward investment, thus it works more indirectly by providing effectively a facilitating role by encouraging experts in engineering within the country which in turn makes the country more attractive to inward investors. It is primarily an indirect role rather than the direct one, but there are specific schemes with which Professor Besant has been involved.

(*Professor Besant*) Yes, I would say that the Royal Academy does provide a marvellous grapevine around the world to link engineers both from industry and universities with their counterparts in various countries around the world, and I think that is an extremely valuable role and obviously contracts do flow from those contacts. I visit Far Eastern countries a great deal, countries like Indonesia, Korea, Japan, Taiwan and so on, and generally, through the links of the Royal Academy and through the Imperial College grapevine, I usually get received at ministerial level when I go to these countries. Of course, it is marvellous from the point of view of linking, being able to link British industry in with industry from countries in the Far East.

565. Do either or both of your departments have any international investment in the research which you are conducting in your respective departments?

(*Professor Clarkson*) Yes, my Lord Chairman. In the University of Wales, Swansea, the two strongest departments are Civil Engineering and Materials Engineering. The Department of Civil Engneering is working primarily on numerical methods in engineering and applying the results to a whole range of engineering topics. This work is supported by the American National Aeronautical Space Agency, by

[Chairman *contd.*]

European Union funds, by our own Research Council and, indeed, by British Aerospace, Rolls-Royce and other industries. That is the most important single piece of significant international research work in my own institution in Swansea. The Materials Engineering Department has strong support from the Research Council, British Steel and other industries as well as attracting overseas interests. These are examples of what the best can in fact achieve. Through this international investment we have contacts with research workers in the premier institutions in the other countries, and that enables us to make sure that not only are we contributing to the international growth of the particular area, but also we are very well aware of where progress is being made in other parts of the world. It is very important for our own industry for us to have knowledge of and contacts with the latest state of the art elsewhere.

566. Would you be in a position, as the Americans say, to give us any kind of ball park figure for the actual level of investment from overseas in your department in financial terms?

(*Professor Clarkson*) I could perhaps let you have a written note.

Chairman] That would be very helpful.

Lord Perry of Walton

567. Could I take up one point. I agree with almost everything you said in your note, but on page 4 you said that: "The figures available suggest the UK receives a relatively high proportion of its research investment from overseas. One reason is simply that UK science funding has formal barriers to prevent laboratories in one sector applying for funds from another ....". I understand the difficulties between research councils, there are bound to be difficulties, but are there formal barriers?

(*Professor Besant*) I would like to, first, give you some indication of the figures that my department, the Department of Mechanical Engineering, achieves from overseas. Our total income from research activities is now approaching £10 million a year, of which 49 per cent comes from the European Commission; 7 per cent from overseas industries; 17 per cent from United Kingdom industry; 11 per cent from research councils; and 14 per cent from United Kingdom government departments. Probably something like three years ago the research council funding was at a level of 28 per cent, and European Commission funding was at 20 per cent. I think more and more members of my department are moving overseas for their funding. Certainly my own section is now almost totally funded from overseas grants. The problem with intellectual property rights features highly now in these activities when we are dealing with these overseas companies; in fact, it is very important in dealing with British companies as well, and features very highly on our agenda because some of the wealth we are creating at the university is tied up in intellectual property and negotiations are usually quite tough. We are having more success in dealing with overseas companies than British companies in the area of intellectual property.

Chairman

568. That is helpful. It would be interesting to know what you mean by "success" in dealing with overseas companies, as distinct from United Kingdom companies on intellectual property?

(*Professor Besant*) We are usually able to come to a successful agreement on the ownership of intellectual property rights. Imperial College seeks to own the intellectual property rights, and give a licence to the sponsor on a first-call basis.

Lord Perry of Walton

569. Thank you for that information, but I am bothered about the suggestion that there are formal barriers in this country to United Kingdom science funding. If there are we ought to try to get them removed. I do not know what they are and I am seeking information here.

(*Professor Besant*) I am certainly not aware of any funding barriers as far as I am concerned in our research.

570. It is easier to get it from overseas?

(*Professor Clarkson*) I think this must relate to a submission that we have had, and we can let you know in writing later.

Chairman

571. Yes, to identify the source of that comment and the reasons underlying it, that would be helpful.

(*Professor Clarkson*) Yes. It does not apply to the universities. We do not have any barriers.

Lord Porter of Luddenham

572. Could I follow up that point, in connection with the particular role of the Royal Academy of Engineering. What you have been telling us about is largely the approaches which are possible from your own colleges, from Imperial College and so on. When it says about the difficulties of "one sector applying for funds from another", I think this looks like a disciplinary hang-up of some kind. I wondered whether you could tell us from the point of view of the Royal Academy of Engineering now, as opposed to your own colleges, what special functions you need and what special functions you fulfil? Are you running absolutely parallel with the Royal Society—with the Royal Society looking after other disciplines and you looking after engineering? What about the Royal Society of Chemistry who have their industrial division and so on? I ask the question in this context because one wonders whether it is in this context that the hang-up, which is referred to here, applies, that is to say between the disciplines?

(*Professor Besant*) I would like to answer that, if I may, my Lord Chairman. I have noted that there have been considerable problems in getting funding from the SERC where you have interdisciplinary projects. It goes to one committee and gets thrown out because it is felt it should go to another committee, and the application gets bounced between committees and, in the end, it does not get funded. The Royal Academy of Engineering of course brings together very neatly people from a variety of disciplines, and it is seeking to foster

[Lord Porter of Luddenham *contd.*]

knowledge from the various disciplines, and this of course is extremely useful. It does have its links with the Royal Society where we can bridge these gaps. I can give you an example: my section is very active in the field of medicine, in particular surgery. There you have a link between the medical field and the engineering field where you are seeking to apply engineering expertise to surgery, and orthopaedic surgery. Here it is essential to establish links between the various disciplines. My colleague who is sitting behind me, and will be interviewed after us, is somebody I have quite strong links with. He represents the medical field, and myself the engineering field. Through our institutions we are able to bridge this gap and have some influence, I might say, on the funding bodies as well.

573. The implication here is that it is better in other countries to some extent. Do you feel that other countries are better at bridging the inter-disciplinary gaps than we are?

(*Professor Besant*) Not particularly, I think. In some countries like Germany they have very rigid hierarchies and bridging the gaps is done better in this country, I think, than in Germany. There are many other countries where people really partition the engineers into very tight areas and this collaboration between different areas, some countries find that quite difficult.

Chairman

574. You will not yet have had the opportunity of assessing whether the change in the Research Councils' structure is going to make any difference to this problem.

(*Professor Besant*) No, I am not getting closely involved in that and clearly they are making some efforts to link the various committees together in some sort of structure.

Lord Porter of Luddenham

575. From what has been said to us, I am still a bit confused about the meaning of this sentence referred to by Lord Perry, so it would be very useful if you could let us have that.

(*Professor Besant*) Yes, certainly.

Lord Nelson of Stafford] It has been said to us by many people giving evidence to us that British firms are much slower in coming forward to participate in scientific programmes, particularly in universities, than foreign firms. I wonder if the Academy, with its unique position of having many members from both industry and academia, have formed any view as to why this is and whether there is any substance to it and, secondly, whether they have any view on a point raised in the evidence we are going to look at from the Royal Society very shortly in which it says this: "...overseas investors are further encouraged by the potential value of United Kingdom generated intellectual property; they also perceive a weakly developed United Kingdom system of exploitation." Now, that is quite a powerful statement from the Royal Society and where it comes from, I do not know, but as you are representing the engineers who are largely responsible for exploitation, I think we would be very interested in what you have to say about those two questions.

Chairman

576. Yes, and before you answer that, could I just add one rider to it because it would follow on very much from what Lord Nelson has said, that we have been told by so many people that overseas companies wishing to invest in this country are prepared to take the long-term strategic view in that they are prepared to look at a ten-year or even longer potential level of exploitation of the results of new research, whereas British companies are more concerned with short-termism and immediate results. Would you like to comment on both?

(*Professor Clarkson*) Yes, my Lord Chairman. I think it is very difficult to generalise about industry, particularly in this country. The best companies, such as Rolls-Royce, British Steel, British Aerospace, British Gas and British Telecom, are very good at investing and working closely with the universities. My own university works closely with several very large British companies and there is not a problem. They are prepared to look at the long term, they do invest in that and they give us the freedom to explore various research avenues which may not be directly of interest to them at the moment and so we cannot complain at all about that. Our main complaint, is that in our own experience the overseas companies are not so interested in the long term. They are out for what they can get in the short term. They come in to buy the specific expertise, whether it be engineering know how or a particular development which they can exploit. They come in and accept the research base which has already been built up here, both by the university funding councils, by the Research Councils and by some of these long-sighted industrialists. It is very difficult to get the overseas companies to pay towards this long term support base. So I think that we should not, and I would not like to, criticise all of our companies in the way you have heard from some of your respondents. Admittedly, there are some sectors of industry which are more controlled or guided by short-term measures and they have the problems that have already been referred to. It is very difficult in a university to collaborate on a very short-term basis and it has to be on a long-term basis.

(*Professor Besant*) Can I add to that, my Lord Chairman, taking British industry, by saying that there are a number of large companies who do collaborate extremely well with certain universities and make a significant investment. For example, Rolls Royce particularly funds a number of universities to quite a high level. My own department has a centre of excellence in the field of vibrations and they put considerable funding into that. I also have created with another colleague a centre of planning applications and we have companies like British Airways, British Telecom and ICL who have made significant investments into that, something like £1 million over the past year, so collaboration from some of the British companies, the large companies, is on the whole quite, quite good. It is significant to see how even some of these large companies are cutting down on their own long-term research and

[Chairman *contd.*]

development. I know, for example, the research laboratory at GEC has halved its staff over the last three years, or something like that, so that is something that we should all be aware of. Now, turning our attention to the SMEs, the small and medium-sized enterprises, which are really the future wealth-creators and employers in this country, so many of those companies really have very little awareness of research. I think we are beginning to make big efforts on the university side to try and link them in with the universities so that they can make the best use of our facilities and really benefit their own research and development. On the overseas side, my own experience is that the investment from overseas companies is quite good, certainly to Imperial College, and some overseas companies do make significant infrastructure investment, such as Honda, for example, who have invested in the wind tunnel facilities at Imperial College, and Fujitsu have invested in a new centre of excellence for a parallel processing computer. These are quite significant infrastructure investments and I think that is important. There is a worry on some of the research contracts that I know of where I am dealing with Japan on handling IPR which is a matter where we do in fact find that the Japanese are quite tough to negotiate with in terms of getting access to our intellectual property and that is something that we have to be aware of in the United Kingdom. There are many, many countries which I think are seeking to collaborate not only with the universities, but also with the industries and they are interested in not just getting the products to manufacture, but they are all after the intellectual property so they know how to make things and then I feel they are going to chop our industries away, so I think it is something that is very important for our industry as well as our universities to be aware of.

577. Do you wish to say anything more about the point Lord Nelson raised about not so much the short-termism, but about the fact that British science is perceived overseas as having a great deal of expertise, a great deal of innovation and inventiveness but is much less good at exploitation?

(*Professor Besant*) This is an area close to my own heart and I am constantly trying to raise significant money to take projects from the university environment through to exploitation. I think many people in this country totally misunderstand the problem of taking a university idea through to the market place. There is a huge area of, I think it is, research development through to a manufacturable product and we totally underestimate what is involved here. I chair a publicly-quoted company in Canada which has invested considerable sums of money into my department for the funding of long-term research in the field of small-scale power generation. I am able, under this funding, to really address the problem of the longer-term aspects of taking projects through this development phase. Some of the work will be done at Imperial College and some will be done outside. This is something where we can actually link the industries in this country quite closely together with the universities to take it through to the marketplace. I would like to mention what has happened in Germany. There they have a very good infrastructure for addressing this problem. They have the Fraunhofer Institutes, and if any of you have been around them you have to gasp at the scale of the investment there. There they can take the university research through a very structured development phase and spin it off into companies which are in the campus of the Fraunhofer Institutes. They have 60 of these institutes and they are on a scale that you would have to go to a Ford factory or one of the large Rover factories to see the infrastructure they have. They are generating some very good small companies, and they are also generating some very bright engineers, who not only are very good academically but have some very good industrial experience. It is a building block I think for manufacturing industry in Germany. We do not have that in this country. I think that is an area where we need to address that very seriously.

578. Yet the concept of the Faraday Institutes, which were thought of as being in some way comparable, did not meet with much approval in this country for a variety of reasons. Is that not the case?

(*Professor Clarkson*) The initial proposals for developments in this country differed considerably from the German model.

Lord Nelson of Stafford

579. Is this a question of the handling of personnel? Has there been in the past too much of a separation between industry and university? I remember when Mrs Thatcher, for instance, cut back on expenditure in universities. Those of us in industry had universities coming to us from all quarters saying, "Wouldn't you like to spend some money with us", and that opened up a whole new chapter of relationships between universities and industry. Therefore I think it proved to be a very good step for the wrong reasons, but it had a very good effect. You referred there to Germany. My experience of Germany is that if you go to visit Germany and you visit a company there you are introduced to Professor This and Doctor That and so on. You say, "Who are you?", and he says, "Oh, I'm a professor at the university down the road". "Dr So and So, what are you?", "Oh, I'm Head of the Department at the university down the road". They seem to combine their jobs and have a function in the university and they also seem to have a function in the companies. If you want to move intellectual property (if that is the right word) from academia, from science laboratories into industry, you have to do it through people. I suspect that is our weakness.

(*Professor Clarkson*) I think that is right, my Lord Chairman. There is excellence here in the ideas and developments in the universities, but we have not got the links quite right yet. We are getting better. Certainly if we look at what goes on in the United States, there is no confusion there about the role of the university or the role of industry. I have worked with industry in the United States—Boeing, for example knows where the experts are in each particular area where they need help in their work, and they can go straight to them wherever they are across the world. They go to them not because they are industrialists but because they are very good at

[Lord Nelson of Stafford *contd.*]

their own academic field. In the United States there is a developed way of getting the academic excellence into industry. Then, of course, there is encouragement, as we have heard, for the academics to set up their own companies. They are generally more entrepreneurial than our average British academic. That is how it works successfully in the United States. We have heard about the German experience which is another way of doing things. I was very impressed, when I visited German companies I have worked with, where for example the chief designer and managing director of VFW, the German aircraft company, was spending one day a week in Berlin and had to travel several hours each time to be in the university. I said, "Why do you do that? Surely you have more important tasks in your company?" He said, "No, this is about the future. I am in contact with the young people who are going to be my young workers in the future". He was prepared to give one day a week to do that himself.

580. Is there something like that in this country?

(*Professor Clarkson*) We are trying to move towards it. We are having professionals from industry going into the universities, but it is still rather too small a number, I think, and has not spread yet. We need people like yourself to spread the message to help this.[1]

Earl of Selborne

581. I would like to follow up the point Professor Besant made a little while ago about the difficulties in this country of linking university research and other research into the SMEs, which is clearly a very special problem. We heard in Scotland two weeks ago of the attempts Scottish Enterprise, as a development agency, were making to link with a number of universities in Scotland. The impression we got from universities was that it was not entirely successful. They are, after all, the regional agency which is specifically set up with that as part of its brief. In England there are TECs but, again, the infrastructure seems to be deficient. Of course, while the sort of proposals you have been talking about in Germany may be very effective for spinning off new companies based on new intellectual property rights, it is a very different problem, is it not, to plug into existing SMEs to try and get the relevant technology transferred and exploited? Is there any infrastructural innovation or change that come to mind, particularly outside areas where there are existing development agencies that might be appropriate?

(*Professor Clarkson*) In Wales the equivalent is not quite the same as the Scottish Development Agency. The Welsh Development Agency has been very successful in attracting inward investment. One of the things it has been doing is to enhance several centres of excellence within the University of Wales and then use these as a resource base to help to attract inward investment. You mentioned small companies, the WDA set up a centre of excellence in gallium arsenide in Cardiff and as a result of that a small company was set up. This has now grown to be an important company on the international scene. That was an example of how an agency could help and use the resource base of the university to attract a company which set up nearby and used the advanced facilities for their initial development work. That company now spends a very large proportion of its income on research and development, (something like 25-30 per cent).

Chairman

582. Some SMEs have told us they have difficulty in getting hold of venture capital. Is this a problem which is brought to your attention?

(*Professor Besant*) Yes, I think venture capital is often very hard to stomach and it is a real problem. My own experience in this area is that the European Commission are making significant efforts to address the problems of the SMEs. In many of the projects I am involved in we do specifically encourage small companies to be involved in these schemes and they, I think, are looking more and more to get money from the European Commission to supplement their research and development, and this is beginning to work extremely well. In fact, Imperial College is now able to manage some of these ESPRIT and BRITE projects and take care of some of the small companies. We are developing very strong links with the SME community through these schemes and that is working well.

Earl of Selborne

583. Is there a formal structure to do that, or is this done by networking?

(*Professor Besant*) It is done by networking. There is a structure through the DTI that can publicise various schemes that are available to SMEs through European Commission funding. We do have some infrastructure in this country for advising companies, and there are workshops that are run by the DTI which are, in fact, well attended by SMEs. I think we are seeing many small companies now applying for grants to the European Commission. I think the important thing is that many small companies now see that their own market is not the United Kingdom but it is the European Union. I think that is very important and they are getting a lot out of working with these projects.

Lord Perry of Walton

584. You describe, Professor Besant, the six places in Germany so well equipped that they could take research to development stage for industrial exploitation. Where do they get their money?

(*Professor Besant*) The money comes from a variety of sources. They get funding from state government, but they also get funding from industry as well and there has been this infrastructure for a considerable period of time that does facilitate this collaboration between the industries and state government and these Fraunhofer institutes and it is very well organised.

Lord Nelson of Stafford] When you say state money, do you mean federal money?

[1]*Note from witness*: The Royal Academy of Engineering scheme for Visiting Professors in Principles of Engineering Design is a good example of such collaboration.

Lord Desai

585. From the Länder.

(*Professor Besant*) Yes. I might just add that I have noticed now with the countries in the Far East a tremendous investment in the university infrastructure there and also in a kind of Fraunhofer-type institute. Taking Singapore, for example, the Nanjing University, there is tremendous investment there and one has to be very jealous to see the equipment that they have compared with what we have.

586. Do you in your experience find that the way that the specific contract is signed with the university hinders some of the entrepreneurial activity you may wish to take up, spending time with industry or being able to?

(*Professor Besant*) If I can speak as I see the world which is through the eyes of the Imperial College mainly, as it were, the Imperial College has always been an entrepreneurial type of organisation to facilitate strong links with industry and, quite the contrary, the Imperial College encourages enterprise and it encourages staff members to be entrepreneurial in their thinking, and it has mechanisms to help people set up companies and form the links with industry and to facilitate that small company placing research contracts, just like any other company, within the university environment.

(*Professor Clarkson*) I think it is the same in most universities now. The contracts of Academic staff would not inhibit entrepreneurial activity. The main problem is not the contracts, but the pressure we put our staff under with continuous audits, teaching assessments and research assessments. The problem now becomes one of emphasis and priorities. The direct funding to the department depends on the research grade of the department and that depends on the quality of each individual staff member and that in turn is assessed by four pieces of written work generally. This pressure to publish that does not sit well with the idea of exploitation where you may want to keep things quiet for a while.

Lord Porter of Luddenham

587. I would like to go on just a little bit further, Professor Besant, about the SMEs and mention something which we have not talked about. In fact this country was always the first in the field and the DSIR some 40 years or more ago had nearly 100 research associations, some of them still in existence, and many of them in engineering. Now, what went wrong? They were exactly what we are talking about when we are talking about the Fraunhofer institutes in Germany. They were half industry and half government funded and they were joint efforts between a number of SMEs. I know one of the problems there was that they did not want to tell each other what they were doing and the collaboration was not there. I wonder, since we have referred to it so much, if you could perhaps tell us why those, which had all the same advantages, have been so unsuccessful really compared with the German and the Dutch and the Japanese similar institutions.

(*Professor Besant*) I think Lord Nelson has hit on that part of the problem which is that there has been this gap between the university environment and industry in general and we have not had this close link between the two through these institutions and, consequently, I think there has not been a flow of new ideas and invigorating ideas both ways.

588. That would hardly be true about Japan.

(*Professor Clarkson*) But, as far as our own research associations are concerned, like the DSIR ones, the main trouble I think was that they were separated from the universities and then, quite frankly, they grew old when it got to the stage when there was no more expansion. Whereas in the universities, the one thing we do always have is youngsters coming through. I think you need to link that with the other ideas of the research institutes in association to get the best of both worlds. You have got to have youngsters coming through all the time.

(*Professor Besant*) It is all about people.

Chairman

589. Was there an image problem in the sense that many people felt that it was more prestigious to work in a major university department than in a major independent research institution?

(*Professor Besant*) I would say one thing which is that now we are actually allowing some of our PhD programmes to actually be done on an industrial site. We did this before the Parnaby scheme in the Imperial College and we used things like the Teaching Council scheme to very good effect where we have very high-grade graduates. We put a team of five, for example, into Rolls Royce to study integrated computer manufacture and it was highly successful because the company employed all those graduates and they have now moved very rapidly into quite high positions in the company, so I think this idea which Lord Nelson had of bringing them all together and transferring people from one side to the other is extremely important. Incidentally, the Royal Academy is facilitating this through the Visiting Professor scheme where we are actually bringing people from industry to participate in the work of the universities.

590. On the question of IPR, intellectual property rights, you say, "Overseas companies without a UK base must expect to pay the full economic cost of research commissioned in the United Kingdom and not be subsidised by the UK taxpayer." Do you believe that the taxpayer is currently subsidising foreign firms in this way? In other words, are universities not charging a sufficient level of overheads? You also say that any commercial sponsor of United Kingdom academic research receives "a very good deal". Does either of your universities in fact operate "UK preference" in pricing research contracts?

(*Professor Clarkson*) Well, we do not have a different preferential scale for contracts. We do attempt to recover the full economic costs of contract work, but we are not always successful in doing that. If we look at the average recovery of overheads, it is something like 60 per cent, whereas, as you all know, the real costs would be something like 100 per cent on staff time. We are in a slight difficulty here because even the government departments which have been pushed up from the 40 per cent, still will not pay much more than 70 per cent overheads, so they are seen as setting the rate. If we could persuade them to

[Chairman *contd.*]

pay a more realistic figure, we might do better than some of our industrial colleagues. However, the difficulty again is that we have a very devolved system in the universities and everything goes down to the individual worker. This individual academic is primarily interested in help in the form of a research assistant or a post-doctoral research fellow, who will work with him or her to pursue the research. If they can get somebody to support that, they will often be prepared to sign away their birthright almost unless the institution stops them doing it.

591. We have heard about the way in which Imperial College handles intellectual property rights. Your document rather suggests that some intellectual property rights may be lost to the United Kingdom economy; but, on the other hand, the danger of over-pricing and of leakage of industrial know-how within the universities are other points that you have highlighted in your report. How are these problems avoidable and how do you handle them?

(*Professor Clarkson*) I think most institutions now are putting in place a very firm IPR policy. The institution owns the intellectual property rights and then generous arrangements are made to pay the individual investigators. That has not been the case in the past, and there has been significant leakage. For example, we had a case where a Korean student patented something he had done which was ridiculous because the institution should have had that right. We have to be vigilant on that point.

592. Do you think things are improving?

(*Professor Clarkson*) I think they are certainly improving.

(*Professor Besant*) I think this is an extremely important area indeed, particularly when some United Kingdom companies are making quite large investments. They are very anxious to protect the IPR, and particularly their own information which comes into the centres of excellence. It has meant that the centres have to have restricted access, and staff and students of course are on specific contracts relating to that work. Of course, this does not go well sometimes with the ethics of scholarship within the university, and it does concern me, but we are getting forced into that direction. It really does worry me as a professor of a University.

593. We have been told by many people that overseas students who graduate in this country, either at undergraduate or more often at postgraduate level, are some of the best ambassadors for helping overseas investment to come to the United Kingdom when they return to the countries of origin. Is this your experience? What does your Royal Academy do in relation to improving our competitive position in the market for overseas students in engineering?

(*Professor Clarkson*) I agree that our overseas students are the best ambassadors. Indeed, this student I have mentioned has ordered a significant number of products of the things we made based on his invention, but it has been difficult to exploit it elsewhere.

594. South Korea, I presume?

(*Professor Clarkson*) Yes. That is the largest market for this particular piece of machinery. That has been helpful in one sense. As far as the Royal Academy is concerned, again, it is a question of enhancing the image of engineering, reinforcing the image of excellence, because overseas students nowadays, particularly good ones (and it is primarily the good ones we are interested in), are very conscious of all the possibilities of education that they have. If you think of South-East Asia, which is one of the major sources of some of best postgraduate students, they have the possibility of going to Australia, Canada, the United States, Britain, France and Germany, and they will weigh up very clearly the advantages of one or other of those. We must not be cheapening our education. Anything that the Academy can do to enhance the image of engineering in this country will support that recruitment drive of the best student. We do not just want overseas students because they pay fees, but want the best ones.

Lord Porter of Luddenham

595. There is a down side to this, is there not? Imperial College has a very large number of students from overseas and they are wonderful ambassadors, we hope, when they go back. Would you not agree that if an SME or any industry in another country really wants to get the lowdown and the expertise and the know-how of what is going on in a very active and good group, let us say Imperial College, the best thing they can do is to have two or three students there at the top level and then they go back home?

(*Professor Besant*) Absolutely.

596. How do you balance that?

(*Professor Besant*) Sometimes it is like having human "Hoovers" going around your organisation!

597. Is this a down side of the international side?

(*Professor Besant*) Yes.

(*Professor Clarkson*) They are ambassadors when they go back. Clearly, the overseas companies and countries do identify departments and they do, as you say, encourage the best students, the best postgraduates, to go to those departments.

598. Would you agree that in some ways what those very good students can take back to their company in Japan, or whatever, is probably more valuable than even the patents and so on, because it comes before the patents?

(*Professor Clarkson*) Yes, I agree with that.

Lord Desai

599. Are you finding, by the same token, you have some difficulty recruiting British students for postgraduate work, or EC students?

(*Professor Besant*) That has always been a problem, that funding has not been sufficient to attract United Kingdom and EC students to higher

[Lord Desai *contd.*]

education. This is a very serious problem. Again, I quote Germany, where they do have schemes in place there to fund people properly when they are doing their PhDs and they are funded to a good level and funded over a good time period. We do not have that.

600. Are any business companies willing to fund student fellowships in your experience?

(*Professor Besant*) Yes. Quite a number of companies do fund students. Sometimes they will top up SERC studentships to an adequate level by providing twice as much funding, and that certainly does then attract United Kingdom students.

(*Professor Clarkson*) There is an increasing number of part-time students and part-time research assistants and research fellows who are working based in British industry, and then they spend part of their time at university; we are encouraging that. Our rules are now sufficiently flexible to handle it.

Chairman

601. Speaking as a medic, one of the great advantages about medicine is that there are many trusts and foundations and charitable organisations that help in this particular field. Is there anything similar that may help towards the support of engineering students?

(*Professor Clarkson*) Not in this scale, no.

602. What can the Government do to make the United Kingdom a more attractive location for inward investment in R&D? What, for instance, could the Government have done to save the semiconductor R&D investment in the United Kingdom, to which you refer?

(*Professor Clarkson*) I think I alluded to one of the things which I thought could be done by government or quasi government organisations; and I mentioned the Welsh Development Agency which has had a lot of criticism recently for other reasons. That has tended to cloud the very good work which it has done and it would be a shame if that is not acknowledged. There they deliberately set out to enhance those centres of excellence which they perceived were present within the university system in South Wales, deliberately going in to support that, and link that with their attempts to target companies overseas. It was not a scatter gun approach, but one to target certain types of companies, and we need this research base to do that. That was very successful.

603. Perhaps we have been a little critical in some of the things we have said, based upon what other witnesses have told us, about the role of British companies. You have put us straight on the fact that many of the larger British companies are doing a very great deal to support research and engineering. We also understand that many United Kingdom companies are now investing themselves much more in research overseas. Is this your experience?

(*Professor Besant*) Yes, sadly, with one or two of the large companies having their research and development declining in this country they are buying it in from overseas.

604. Why?

(*Professor Besant*) Certainly in the field of power generation. There used to be the two big power generators which used to have the CEGB laboratories which funded a tremendous amount of R&D, which has now gone. What R&D they have now is just bought in with no long-term R&D funded at all by the two major power generators, as far as I can see; it is on a trivial scale.

(*Professor Clarkson*) There is a different situation in British Gas, but that of course might change as a result of the changes taking place following the MMC report. The company has a very major central research activity there are more than a thousand research workers based in the Research and Technology Centres in Loughborough and Newcastle. They are able to keep a research base going and also invest overseas in things which are not directly competitive, for example, environmental problems. There are programmes where they are working with the Germans and others in Japan. When they bought Consumer Gas, in Canada, they agreed to offset some of the money into research and they put four professors into Canadian universities.

Lord Dean of Beswick

605. I think you mentioned that there appeared to be some slippage in the investment of research regarding investment in nuclear energy because of the new structure you talk about. A few weeks ago at this meeting I asked some people who were giving evidence, the same as you, was there a question as to whether our being in the front of this in the nuclear energy race was suffering and they gave a categorical undertaking that it was not. Well, there seems to be a contradiction there.

(*Professor Besant*) Can I just say that I was not really thinking of nuclear energy, but I was thinking really of National Power and PowerGen, the two companies.

606. But it is linked in eventually, is it not?

(*Professor Besant*) Yes.

607. Nobody else is going to use nuclear power in this country, are they?

(*Professor Besant*) No, I would agree with you that the funding on the nuclear side has been good. I have worked in the industry in the United Kingdom myself and that has on the whole been well supported.

Chairman] Thank you.

Memorandum by the Royal Society

Question 1. *What is the extent, nature and variety of overseas investment in UK science? How does this compare with investment by UK interests in science overseas?*

International investment in UK science might be seen as comprising five elements.

(i) *Large science projects such as JET* (supported by an international fund to which the UK contributes). However, we note that although the UK *economy* benefits because of the location of such research in Britain the "inflow" of funds into UK *science* is offset by UK investment in similar projects overseas. The UK does not win many such projects and should endeavour to gain more.

(ii) *Location of R&D centres.* Foreign companies may establish in the UK to extend their own internal R&D by establishing a laboratory either close to, or on, a University campus. This may be occasioned by a previous or accompanying investment in manufacturing or may lead to manufacturing.

In seeking to delineate "inward" and "outward" investment where multinationals are involved the picture is particularly clouded. For example in the pharmaceutical industry British-based companies such as Glaxo, Zeneca, Smith-Kline Beecham and Wellcome, in addition to their substantial UK investment, also have major research operations overseas.

(iii) *Small scale contracts and projects.* Apart from R&D centres there is considerable investment from overseas industry in smaller scale activities—in research contracts, collaborative projects or in some form of sponsorship such as of "Link" schemes, postgraduate courses or studentships; or participation in sandwich schemes. Overseas companies often invest in sponsorship of meetings or conferences.

(iv) *Shared projects under the EU.* These are probably neutral in terms of overall cash balance; the UK would appear to receive a fair share, and what it may gain in some areas is offset by what it contributes elsewhere.

(v) *Investment from Overseas Government Agencies.* There is little sponsorship of overseas science by the UK government whereas many foreign governments invest in the UK. An example of substantial inward investment is that of the US Department of Defense which has spent some $200M in the UK since 1985.

Question 2. *What factors influence potential investors in deciding whether to come to the UK for science, or to go elsewhere? (whether elsewhere in the EC, or elsewhere in the world)*

The UK has an international reputation for high quality research and generating new knowledge. It is home to many world-leading research groups and it still houses some leading facilities such as the Rutherford Appleton Laboratory (RAL) and Daresbury, which have sound infrastructure and well-defined methods of access. Another example where the UK offers particular opportunities to investors is the National Health Service which represents an invaluable resource for research.

Overseas (and UK) companies may fund excellence wherever they find it, so it is important that the UK maintains its record for high quality research. Overseas investors may also be influenced by other factors. For example, by sponsoring "frontier" groups a watching brief may be maintained on new developments; joint projects may generate cross-germination of ideas.

Taking a more commercial viewpoint many companies, especially those from advanced technology industries, function in a *world* market and therefore establishing R&D centres (and perhaps manufacturing bases) throughout the world helps to penetrate overseas markets. The UK market may be chosen in its own right or as a strategic base for business entry into the European Union.

The cost of "science" in the UK (particularly the university sector) is still comparatively cheap especially to investors from the USA or Japan. These overseas investors are further encouraged by the potential value of UK generated intellectual property; they also perceive a weakly developed UK system of exploitation.

The UK is also held in high esteem for the calibre of the graduates and postgraduates it produces. This attracts students from around the world, and they bring with them funds from a variety of sources. Collaboration with higher education institutions puts investing overseas companies in touch with UK experts they may later wish to recruit.

The current situation is not robust and concern is already being expressed that the UK may be losing its "nation of choice" status because of increasing costs coupled to over-aggressive marketing by UK

institutions. The research infrastructure must be maintained by the UK Government to maintain attraction to overseas investors.

Question 3. What are the benefits to the parties concerned, and the wider UK economy? (both short- and long-term, both tangible and intangible—including such matters as training, employment, intellectual property, access to and exploitation of results, one form of investment attracting another)

International investment undoubtedly strengthens the UK Science Base and is strongly positive in this respect. More better funded and better equipped individuals and groups are able to perform more effectively in their areas of expertise and to enhance their own and their institutions' reputations. Overseas companies generally tend towards a longer term view of sponsorships than UK firms. Thus researchers may get the opportunity to explore ideas that might otherwise go unfunded either because of the constraints on the Research Councils or the short-term outlook of UK industry. However it must be understood that overseas companies do not invest as an act of philanthropy and the importance of intellectual property ownership and exploitation must be borne in mind by researchers. We return to this below.

A stronger Science Base also allows for better education and training and more scientists, especially in sectors of high investment such as biomedical science. Developing a skilled workforce for the UK is obviously beneficial. In addition overseas graduates and postgraduates return home with their skills and knowledge gained in the UK and, hopefully, will transmit a positive message. Similarly well-trained British scientists who work abroad also serve an "ambassadorial" role as they demonstrate the quality of their background, and may provide subsequent commercial benefit to UK industry operating overseas.

More advanced and substantial experimental facilities may be available in the UK than would otherwise be possible through involvement in large international science projects such as JET. Other expensive facilities set up predominantly by UK public funds (such as RAL) may be better exploited (attracting investment) through international projects. Large science programmes like JET bring with them jobs, a boost to the local economy of the salaries that accompany those jobs and they support associated high-technology industries. These considerations are particularly important in the long term. Multinational R&D is the most important in terms of size and immediacy of impact on the UK because of its effect in developing the infrastructure and downstream activities.

Inward investment in R&D brings with it (ultimately) business activity, and possibly manufacturing activity, but this may be vulnerable as overseas investment is often the first to be pruned in hard times. There are also financial gains both to the research institution, receiving investment directly, and to the wider economy.

What is to be gained by the overseas sponsor/partner? Investors may gain from new developments and solutions to particular problems. They will gain access to a broader science base and useful contacts, and through this will have the opportunity to assess potential employees, gaining a recruitment advantage.

The contact or collaboration brought about by international investment facilitates exchange of information which is of direct benefit to all parties involved. However special attention needs to be paid to intellectual property, access to which is a further benefit to investors. The UK participants must take care to make sensible agreements for ownership and licensing of IP.

Question 4. What is the level of expenditure by investors, and are there costs (direct, indirect or intangible) to the hosts?

We do not have information available in order to comment on the level of expenditure by investors.

There is a possible cost to the Science Base. We are concerned that because of the need to attract industrial (both UK and overseas) funding there may be a shift in emphasis away from basic and towards more applied science, to the detriment of the knowledge base. Also that, in the long term, success in attracting "external" funding must not be seen by Government as an opportunity to reduce public funding.

We are also concerned at the administrative complexity of involvement in some European science programmes. There is a danger here that good active scientists become grant administrators and processors, to be replaced by less skilful and knowledgeable temporary scientists to do the research.

Question 5. What are the policy implications for the British government and British science?

International investment provides excellent opportunities for UK science provided both the immediate *and* the long-term return to UK Ltd is ensured. As mentioned in response to earlier questions international funding into the UK is not guaranteed and foreign governments and companies will fund the best wherever that may be located. [Universities are therefore vulnerable if the infrastructure is eroded.] The government must therefore follow a strategy which invests in university infrastructure to maintain excellence, thereby continuing to attract investment.

The Government needs to facilitate further the process whereby science and technology become wealth-creating both through home based funding *and* inward investment into the UK. Means must be developed to improve UK commercial exploitation, in order to make the very best use of UK inventiveness.

SUMMARY

In order to keep up standards UK science must continue to attract overseas funding. The institutions that invest here do so because of the perceived high quality of the science base, but there is an increasing perception of an erosion of that science base. Maintenance of the research infrastructure by the UK Government is essential. If healthy internal funding is not re-established, then overseas investment may shift elsewhere.

Special attention needs to be paid to intellectual property and UK participants must take care to make sensible agreements regarding ownership and licensing. To capitalise fully on UK inventiveness means must be developed to improve UK commercial exploitation.

The situation in the UK with regard to the benefits and penalties of attracting international investment is not unusual nor is it in any way sinister. It is simply part of the scientific and commercial competition that characterises modern society.

Examination of witnesses

Professor J H HORLOCK FRS, Treasurer, DR I R YOUNG OBE FRS, Fellow, and DR L L IVERSEN FRS, Fellow, the Royal Society, were called in and examined.

Chairman

608. Thank you very much indeed, Professor Horlock, Dr Iversen and Dr Young, for coming.

(*Professor Horlock*) Thank you very much, my Lord Chairman. May I introduce myself? My name is Horlock, I am Treasurer of the Royal Society and I work in my own laboratory now a couple of days a week, the Whittle Laboratory in Cambridge, which is one of the Rolls Royce centres of excellence which I think Professor Besant referred to. I am also a director of one of the privatised electrical companies and so I have two hats. We did consult very widely. We had a range of extremely interesting letters and the paper is really an attempt to distil that into a consensus view, but I have asked Dr Iversen and Dr Young to come along because they have particular viewpoints and Dr Iversen comes from a multinational company and is the director of a research laboratory in this country and Dr Young has particular experience in relation to medical imaging, so they might perhaps just say a word and then I would add one or two points, if I may, from the Royal Society.

(*Dr Young*) Thank you, my Lord Chairman. I am a curious hybrid, I suppose, in that I am a physicist turned electro-engineer and I work for about 17 per cent of my time at Hammersmith Hospital, the Royal Postgraduate Medical School, and the rest of the time I work for a GEC medical subsidiary in Cleveland, Ohio. A great deal of my funding comes actually from America and the rest comes from the Medical Research Council. It is a rather curious mix. I have some knowledge of the problems and perhaps a rather negative view of British history in this affair.

(*Dr Iversen*) I work for a multinational company, Merck, Sharp & Dohme, one of the largest pharmaceutical companies in the world, and I am a recipient of overseas investment. I was an academic scientist in Cambridge and ten years ago I joined Merck, Sharp & Dohme to develop a new research laboratory in this country. I would say perhaps my message to this group would be that if my company was to take the decision today, we probably would not be building a laboratory in Britain, and I can elaborate on that.

609. I think we would be interested to hear you elaborate on that later, but, Professor Horlock, you did say that you wished to add something from the Royal Society.

(*Professor Horlock*) Yes, perhaps just a word or two about the consensus view, I think, which I have tried to distil, my Lord Chairman. We have followed your questions in detail. I think perhaps the point which has not come over is that one of the major functions of the Royal Society is to select and support very high quality people. We have the Royal Society professors, 12 or 15 of them, and we have now 215 university research fellows who are pretty senior people, probably the future fellows of the Royal Society, I think, and this is an enormous research strength. It is an elite corps which is working in the universities in the country, so our role really is to work through people in this way. To summarise the consensus view, as I say, I think there is a major concern about the support of the infrastructure and whether this is being eroded, and you will hear this again from my colleagues. It is absolutely essential to maintain that infrastructure, to maintain the quality which then encourages the inward investment and this is the basic message which we want to get across. As far as intellectual property rights are concerned, there is a miscellany of views. Undoubtedly the universities have been getting their act together, as you heard from the Royal Academy of Engineering. We have concern expressed to us about exploitation by industry in this country, but a range of views and I do not think we could generalise too much from it. I summarise in the paper a view that Sir David Jack of Glaxo put in saying that there was nothing unusual about the situation and nothing sinister. He felt it was a normal situation which would exist in many countries and was not actually unusual in comparison with others. That is the simple view, the simple consensus view.

610. Well, thank you very much. Of course I am very familiar, as Dr Young will know, personally with the imaging activities of Hammersmith and I know David Brooks and Richard Frackowiak very well. Could I ask you then just one point of importance and it is relevant to this whole question of

[Chairman *contd.*]

exploitation in Britain. The very first CAT scanners were made in the United Kingdom and of course that was a British invention, but none are made in the United Kingdom now. Can you give us any reasons? There are so many other examples of techniques and developments of medical imaging which were initially exploited, but that exploitation did not continue. Are you aware of the reasons why this has proved to be the case?

(*Dr Young*) They are multiple. I think that you could ask almost as many people and get almost as many views. Interestingly, on the CAT scanner, there was a little book published by a Dutchman last year looking at the introduction of new techniques into medicine, and he took imaging as an example. The CAT scanner was the third British disaster, whereas MR was the fourth. How any one country can manage to screw up in the same way four times in a row is almost unbelievable, but we did. The reason I think is, firstly -and it is certainly true of my attitude and it is true of GEC's attitude—there is a lack of confidence in the large British companies. They believe that since America is *the* market (and until recently represented about 50 per cent of the medical imaging market but it is now declining and it could very well be a terminal decline and there may be huge changes on the way because of the impact of health care reform) they felt they had to go to America, and they could not use their own management the way that, say, Siemens and Philips do, and they go to America or they use the Germans. We went and we used the Americans and we did not understand these. The intellectual property which we own is very nearly valueless. I do not really know why this area of technology is so bad. If you look at what has happened, say, to EMI, where the patents are simply infringed globally, unless you are strong enough that you are prepared to invest £1/2/3 million in defending your patents, they are quite confident that they will destroy you in the end. They collude. There is a very interesting patent case going on at the moment involving a German academic institution, one of the Max Planck Institutes, with infringement both in Europe and in the United States; and the companies, even though they may be ostensibly competing (and there are some curiosities about this patent, how it got granted and the German connection through the European Patent Office, and the German institutes and Siemens etc) in fact collude behind the scenes. One knows this, and I have not given any evidence for the company with which I am associated but I have for at least two of the other defendants. I do not think it is a strong case at best. I think intellectually one could say that the patent should not have been granted, because there were no less than two publications in the English language press describing it before the patent was ever granted or before the patent was applied for, but that is a different issue. This is not the first time—certainly the companies collude. They have one thing in common, if they know that one of them loses the rest will lose. We have that as an issue. I think intellectual property is nearly worthless in this case. BTG in its earlier embodiment as a government agency was actually seen as being the British Government, and they can generally accept that the British government have a longer purse than they do. BTG was a credible supplement for licences. I think in a typical university they would not waste five minutes on it. If you are prepared to put down £3 million to defend and prosecute your case in America, that is fine, but I suspect there is no British university that would dare or could afford to do that. I think there are other reasons. There is a weakness in the medical profession in that it prefers to buy comfortably from Siemens in particular, and Philips. These companies have long connections with academic radiology departments. You can go on with the reasons, but I think there is a catalogue of disasters.

611. Professor Horlock, you have talked about infrastructure and one thing, of course, which is not immediately relevant but you may wish to comment upon is the decision that was made about the removal of infrastructure funds relating to research council contracts from university funding? Is that one of the factors which has caused you concern, or is it a much wider level of concern?

(*Professor Horlock*) It is a wider issue. It is the deterioration over a period of years I think, my Lord Chairman. I think Dr Iversen would see it from his point of view as well.

612. Turning to Dr Iversen, one of the points which has been made to us from many, many quarters is that perhaps the greatest British success in achieving overseas investment in science has been in the pharmaceutical industry; for example, you know about the support that came from Bristol Myers Squibb for the development of pharmacology at Oxford, or the Yamanouchi investment in Oxford, and we have heard of many others. That has been an area of great success in attracting overseas investment, so why would you say now that Merck, Sharp & Dohme would no longer consider spending such a large amount of money establishing a research institute in this country?

(*Dr Iversen*) I think it is an interesting contrast with Dr Young's tale of woe. The pharmaceutical research based industry is a British success story—one of our few science-based home-grown industries with leading international players. It is because of that success that overseas companies have wanted to have a presence in this country, because of the excellence of the biomedical and chemistry research available; and that is why my company set up. I think the change, however, in the last ten years has been gradual, as Professor Horlock said. The erosion of the science-base infrastructure has been so gradual it is not easily perceived. Looking back, certainly I see a weaker position today in terms of our failure to spend an increasing amount of our gross domestic product on the science base, and the actual physical erosion of the university plant. If you go around British universities nowadays they are very depressing places which have not been decorated or repaired, and the equipment is obsolete in many cases. We are failing to keep our standards up to international competitive levels. If you contrast that across the Channel with the huge spending by the French and Germans on just those very things in the last decade, I think it is unfortunately the case that we are no longer as competitive as we were ten years ago. That is perhaps the most important factor. Influencing our decision in the first place was the

[Chairman *contd.*]

perceived excellence of the British science base. I have to say also, as a business environment, from our point of view as a pharmaceutical company, and now speaking on behalf of MSD rather than the Royal Society, MSD and other companies now find Britain a less and less friendly place to do business. The government has become increasingly invasive in its regulation of the way in which we do business. Although I know the Association of British Pharmaceutical Industry told you they believe the pharmaceutical price regulation scheme should be supportive of innovation, I am afraid we disagree with that. We find that scheme to be increasingly limiting our capacity to do research. There are artificial ceilings, for example, placed by the PPRS in the amount of research spending that companies can be allowed to offset against its profits. There is an arbitrary ceiling which we routinely exceed every year. There is a ceiling on the amount of money we are allowed to spend on medical education in promoting entirely normal products that doctors have not come across before. As an innovative company we feel we are penalised for that. I am not a businessman so I am not really in a position to give you the full details of our criticisms of the PPRS, but my company feels very strongly about that as a negative factor in doing business. There are a variety of factors to influence our decision. In fact, our new overseas investments have gone, in recent years, to Italy, Japan and Canada.

613. The interesting thing we have been told from many quarters is that the highest proportion of overseas investment from Japan and from the United States in all fields of science has come to this country in preference to many others. I wonder why that is? There is an incompatibility between the point you just made and that particular statistic. We have, of course, heard from so many other quarters about the run-down nature of university departments and the paucity of modern and expensive equipment—we understand that fully and that is something which has been said to us—and yet we have been told that the Americans still have a very high regard, as you have said, for the quality of British science, not just in pharmaceuticals but across the board. The Japanese are likely to be continuing to spend rather more here because they say that they find the cultural background to British science and its quality and the environment increasingly attractive in comparison, for example, with the United States. They say we laugh at the same jokes, for example. Are these factors of which you are aware or are these factors declining, do you believe?

(*Professor Horlock*) Perhaps I could comment on that, my Lord Chairman. I have just been to Japan on a Royal Society delegation and we visited several universities, several research institutes there, and it is an interesting picture. I would not say that the Japanese universities are well equipped at all. In my own field I would say they are poorly equipped. The research institutes are extremely well equipped, as Lord Porter will tell you no doubt, and it is a different picture. I went to Mitsubishi and I was advised there that they would not expect to put their money into Japanese universities, but they preferred to put it into the Whittle Laboratory in Cambridge and support the group there and because of this different atmosphere that you referred to. I think perhaps in saying that the infrastructure has deteriorated, we should not say that the equipping of the centres of excellence has deteriorated. It is probably a wider thing than that. I would think that the centres of excellence that we do have and which have become sharper in definition over the past few years are still worthy of investment from Japan and overseas.

614. To turn to a rather more general topic, what does the Royal Society itself feel that it can do to encourage overseas interest in British science and in helping United Kingdom institutions, universities primarily but others as well, to attract overseas investment?

(*Professor Horlock*) I think we would say that we do not expect to help directly and we would expect to help by our support of individual scientists, the Royal Society professors, the university research fellows, who themselves will obtain overseas investment, so we would expect to do it indirectly, but the other thing which I should emphasise is the massive international exchange programme which we have with overseas academies, overseas universities, and that furthers the cause of international science generally. Again we would not be specific in saying that we support particular inward investment, but this interchange brings research students to this country and this indirect value is very considerable.

Baroness Perry of Southwark

615. Slightly shifting the topic, if I may, my Lord Chairman, I was very interested in the Royal Society's comment that the concern expressed about the current situation included over-aggressive marketing by United Kingdom institutions, and I wondered what anecdotes or statistics lay behind that comment because that is something fairly more within our control than many of the other factors.

(*Professor Horlock*) It came through, my Lord Chairman, in two or three comments from this range of fellows that we consulted. I picked it up as well. I think, with my industrial hat on, that some industries are now saying that universities are charging too much and pressing too hard and, paradoxically, it is some of the most successful ones that have been doing that, but the kind of overheads that you heard Professor Clarkson talking about an hour or so ago are at about the level I would expect across the universities and many universities are now trying to get much higher than that and British industry is tending to react against that.

Chairman

616. Yes, but not as high as Stamford.

(*Dr Iversen*) I think probably as somebody having to deal from an industry point of view with British universities, there has been a very proper rearrangement of their affairs to take into account intellectual property which they never took much account of before, but there has been an over-reaction, and I can give you one anecdote which is in your own field, my Lord Chairman, of discovery. A very significant discovery about Alzheimer's disease

[Chairman *contd.*]

was made at St Mary's College, the University of London, just a few years ago. The discovery was a precise understanding of the molecular defect in certain rare cases of Alzheimer's disease which are inherited in families and the genetic defect was pinpointed. The university filed for a patent on its biological discovery which would thus preclude anyone from taking advantage of it to invent new treatment of the disease, and that is quite right and proper, but we negotiated with the University of London to obtain a licence and at some point in the negotiations we were told that the negotiations were terminated because the university had given all exclusive rights to a Californian company, so that discovery made right here in London is now not one which can be exploited in this country, which I think is an example of over-zealous behaviour on the part of the university to get the maximum cash return.

617. And of course Dr John Hardy then took his entire team to the United States.

(*Dr Iversen*) As a corollary, yes.

Earl of Selborne

618. I would like to ask Professor Horlock if he could help us on the need to endeavour to gain more large international science projects. It seems to me that the decision, alas, as to where these projects should be sited is not always made on grounds of scientific preference and there is clearly a lot of negotiations which go on for quite different reasons. Do we have the right structure in this country in order to advance the case? Does the Office of Science and Technology address this issue and should other government departments, such as the DTI, be more proactive?

(*Professor Horlock*) It is a very interesting question that you put. I thought my immediate response was that I could not see a universal mechanism which would deal with the whole area and we would have to deal with cases as they came up, one by one, and press our case. I suppose it is early days for the Office of Science and Technology to pick this up, but they might well do so, but I have difficulty, I think, in seeing how a structure could deal with it. I think one would just have to pick up the cases as they arise and press the British case.

619. Do you see any evidence of this happening at the moment on a specific project?

(*Professor Horlock*) There was one that we did hear about of a new international project which might be located at Rutherford Appleton and we were urged to press the case for that.

Lord Desai

620. I wanted to pursue what Dr Young said about British assets. Would you advocate that universities now go back to pooling their resources in some form to defend assets against theft, as it were?

(*Dr Young*) Absolutely. I think, my Lord Chairman, that we lost a very significant national asset when BTG was privatised. I think this will be seen in years to come to have been a very serious mistake. Leaving aside the issue as to whether there was and whether the Government would have supported it, there was this impression that it would have supported it, and I think Dr Iversen's industry is very different from our own, but I do not think that the problem is as general as one might or as I might paint it, but certainly I think in general electronics where licence royalties are very low, there is a tendency to infringe first and argue second. Things move very quickly. Pharmaceuticals of course has got the large time lag imposed by the regulatory process which, while it is beginning to exist in medical equipment in America and does exist in medical equipment in America, does not as yet have the same impact and, therefore, we tend to be much swifter at moving. Certainly under present circumstances I would think that in my own area no individual university would find it worthwhile to do anything; and collaboration assigned to the patent would be a logical thing to do.

621. To refer back to Dr Iversen's anecdote, it would be tempting for a university to get into a quick marriage, rather than think of the national interest, if they had a company which would exploit it. We are always urged to be entrepreneurial but now I think we are too entrepreneurial for our own good. I think the pressures are extremely heavy on universities to go and seek the best buyer regardless of nationality, as it were.

(*Dr Iversen*) My Lord Chairman, I did not intend to imply that the university did anything improper. They are reacting as the pressure has been put on them. It is ironic, is it not, that a major discovery in a very important disease cannot be exploited in this country.

622. As an economist I can be slightly more relaxed about it. Surely there are other people's inventions here so it cancels out at the end of the day, or maybe not?

(*Dr Young*) We are very much a network supporter of intellectual property. I do not think that your argument is particularly well founded for that reason. Yes, we lose far more than we import.

623. But, by the same token, you have been the main exporter of capital for 150 years!

(*Dr Young*) You could not say that had done much better for us either!

Chairman

624. Turning to the question of export, can you give us any other examples of substantial investment in United Kingdom science by foreign governments, besides the US Department of Defense? Does the lack of reciprocal outward investment by our government work to our advantage?

(*Professor Horlock*) I went through all the replies I had, my Lord Chairman, to see whether I could find evidence of this, and the only one I could find was of US government agencies investing in Cambridge work on combustion, for instance. That was the only one I could find. I do not know whether my colleagues have any other instances.

625. Another question of great relevance is, you say that overseas investment by all countries is often the first to be pruned in hard times, in times of recession. Are you aware of areas of British science,

[Chairman *contd.*]

in the broad, which may be over-dependent on money from overseas at the present time?

(*Professor Horlock*) Yes, I go back to the one I just mentioned, combustion research in the Engineering Department in Cambridge. This is the work of Professor Bray, a very high quality group. He told me in fact that his research group is funded mainly from multinational and overseas sources, since there are few United Kingdom investors in this field. Of course, in days gone by Rover, BL and Ford all invested in Bray's group, and its predecessor, which no longer happens. We now have a very strange situation really of absolutely first-class international scientists working on combustion without industrial support from this country at all; because the industry just is not in that business any longer. There is one example. It is rather a sad letter to receive really, that this group no longer has a rapport with British industry at all, only overseas industry.

Lord Porter of Luddenham

626. This has a very long-standing history, has it not, over 40 years in fact. The Office of Naval Research was one of them, and the Washington Laboratory funded combustion research in particular?

(*Professor Horlock*) Yes, indeed. It is worldwide.

627. Particularly in this country, of course?

(*Professor Horlock*) Yes.

Lord Porter of Luddenham] It does seems that once you have established and got a reputation of this kind it is valuable for a long time.

Earl of Selborne

628. We have touched a number of times, have we not, on what is clearly the case that, as the manufacturing base shrinks, so the mismatch between the science base and the home manufacturing base is bound to increase. One could argue, and I certainly would not wish to, that there is therefore a case for a diminishing science base reflecting that they are not going to be able to generate further jobs and added value. The argument (I hope you will agree with me) which is much more sound is that we should seek to be much more internationally responsible and recognise that we will simply have to fund part of the work from international sources and expect it to be exploited internationally. Would you like to comment on that?

(*Professor Horlock*) I think I would add another point: in that people like Bray, with an established reputation, should perhaps be flexible and think about moving to other allied areas which may be of more direct interest to British industry. Of course, that is not always the easiest thing to do later in your career. Flexibility in moving from one field to another is important.

Lord Porter of Luddenham

629. How can such a basic industrially applicable area like combustion not be of interest to British industry? Surely it involves internal combustion engines and motor cars. How could it be of no interest to British industry?

(*Professor Horlock*) If you take the wider industry, I agree with you. I was merely making the point that the internal combustion industry in this country through the motor car industry has contracted so much that there is no longer that particular interest. As far as boiler manufacturers are concerned, it should still be there.

Chairman

630. I am now being deliberately provocative, of course you are well aware that one reason why the motor car industry declined was because of the lack of quality of the product and perhaps because of too much diversification. As Dr Iversen has said, the pharmaceutical industry is at present one of the jewels in our industrial crown, and there are others too of which we are all well aware. Going back to what Dr Young said—and I think some of the strictures on the medical profession are perfectly justified in saying they tend to seek equipment overseas—quite apart from the CAT scanner, our invention, most of the magnets for MRI scanning were made by Oxford Instruments in the very early days. We used to make very good electron microscopes, we used to make large numbers of high quality pieces of medical equipment but, frankly, one of the reasons why customers moved overseas was because the quality of UK products declined steadily in comparison with many of those of our overseas competitors. Is that a fair judgment? Is there evidence of improvement now taking place in British industry?

(*Dr Young*) In terms of the medical industry, I do not think there is one in this particular area. There are a couple of ragbags and there is still Oxford Magnets, and we still make a lot of the world's magnets. Most of the software which was used for this was developed in this country by Rutherford Appleton and the University of Bath, which has been sold overseas. We had a problem with a Finnish company the other day which believed in zero loss infinite permeability iron. When we applied the Bath software ourselves it finally vanished overseas and is now made in Finland, and we will see nothing for it. It is a chicken and egg situation. Certainly a tremendous amount of the problem lay in the health service and the health service purchasing procedures, because the thing which British industry found very hard was to develop referral sites of any kind. It is ironic in fact that GEC medical referral sites are actually in the United Kingdom, but that is the exception rather than the rule. If you look back, for example at the early history of CT, that was more or less a complete disaster, as the first Siemens and first GEC machines were. That was a direct contributor in that case. The Commission simply said, "Well, we will get it right. We will put up with this" in a way in which I think in fact they would not have done for a British manufacturer, and in fact in due time we did get it right. EMI then proceeded to get it wrong in a rather complex series of ways, falling out amongst itself rather than anything else, but one of the troubles with this business is that a lot of the revenue that all medical equipment generates of course is service revenue because commissions require instant service. I am not ever really convinced that there has ever been a major perceived quality difference, but I

[Chairman *contd.*]

think a referral base difference, a lack of domestic market, a lack of aggressive support by the Department of Health in terms of placing equipment and getting it going and helping people to do research on it in the early days.

631. Do you think we are getting better? We ask each of you, are we getting better in this country at exploiting British inventions, bearing in mind the problems of the infrastructure to which each of you has referred and is the overall situation improving? If not, what can be done to help to improve it?

(*Dr Young*) In our case the answer is almost certainly no and this arises because of changes in the Health Service research programme. This is now almost entirely money for evaluation and there is very little support indeed for the introduction of equipment for the programmes that used to be run with fifty-fifty funding at that stage. It is almost entirely evaluative. It is almost all low-level pseudo-epidemiology in fact and as a result if you came along with a new, highly interesting, highly innovative device for clinical evaluation in this country, short of somebody getting MRC money or Wellcome money, it would simply collapse. There would be no way of introducing it, whereas in the old days through the old way of introducing money through the science branch there was a mechanism.

632. And yet while I wholly accept your point, in the early days of the EMI scanner there was one stage when there were four EMI scanners funded by the NHS in the whole of Great Britain but there were 42 in Manhattan of which about ten had been bought by practitioners for use in their own private practices. The point, nevertheless, is that if we produce a high quality product, it would be sold overseas even if our own National Health Service did not buy large numbers.

(*Dr Young*) It is very interesting because I did a study which I actually published in America after heavy editing as they refused to publish the original and what happens is that there are four dominant medical equipment companies in diagnostic imaging and I think the same pattern probably exists in chemistry and with people like Hewlett Packard and so forth in other fields, and these companies have very close working relationships, long-time working relationships with a small number of very prestigious academic institutions. They persuade these institutions to hold off purchase until they have their own equipment available and then give them the equipment under very generous circumstances. A lot of research money, which may actually come in terms of additional research fellowships, may come as free equipment, free support, all sorts of things, and you have a sort of equivalent dictum to the old IBM one that nobody ever got fired for buying an IBM computer or nobody ever got fired for buying a GE X-ray machine, and they control the markets through a number of prestige institutions who are regarded as authorities and training institutions, and in all cases they have succeeded. The GE was a classic ploy and they succeeded in stopping the market for two to three years until they were ready. Siemens colluded and that was it because they dominate.

Lord McColl of Dulwich

633. Going back to medical equipment, and let us take, say, artificial legs, I chaired a government enquiry into the supply of artificial legs and wheelchairs and all the things for disabled people and what amazed me was that the British companies were not exporting anything and that made me very suspicious. I asked them why and they said it was very difficult to export artificial legs. When I found out that Germany was exporting to, of all places, Israel, I knew there was something fishy going on. Really the problem was that the Civil Service were negotiating with monopoly suppliers cost-plus contracts for 40 years with no system for controlling the costs and the plus is only 16 per cent and part of the costs were the research monies for which the Government got no benefits whatsoever. Is that just an isolated incident or has this been going on in other fields?

(*Professor Horlock*) I do not think I have a particular comment from my own area. I do not know whether my colleagues do on that one.

(*Dr Iversen*) We certainly do not have a cost-plus contract with the Government, no.

Baroness Perry of Southwark

634. You wish you had, no doubt!

(*Dr Young*) I think this might have been fairly unique. I suspect anything involving prosthetic devices, which gets you into a huge area of very complex regulation, is one which is unlikely to be as simple as other areas. It is a semi-cottage industry, as I understand it, is it not, not really a fully-fledged normal industry?

Lord McColl of Dulwich

635. No, but if you take something like keyhole surgery, which is an enormous field, we try to buy British products, and we try to encourage British companies to make products and the moment we have something worthwhile, we are bought out by an American company and off they go, so what can we do about that?

(*Dr Young*) Well, we are starting again. We are actually redeveloping endoscopes and things of that nature to work in imaging environments and in MR machines where the whole material is entirely different from anything you have got. We are working with a couple of small British companies and there is no reason why they should not really be able to take the ball and run with it, but already they say, "Well, Olympus dominates the endoscope market, 97 per cent of it in the world, and once the numbers are big enough to interest Olympus, we are required to get out again", but this is an area which is experiencing a revolution, just as there was a drug revolution at the end of the last war, and there is an enormous opportunity for the country. It is interesting because the Americans are in such a tizz (a) about healthcare reform and (b) about medical legal issues, and while they talk a great deal about things, many of the things are being done in this country and we have a glorious opportunity and another unrepeatable opportunity, and I will not go

[Lord McColl of Dulwich *contd.*]

as far as to say it could be the fifth disaster, but I think it is likely.

Chairman

636. We must not pursue this too much, but there was a time when we used to make practically all the X-ray equipment in this country and then there came a time when it was practically all made in Sweden, a country which one cannot regard that as being a major industrial competitor. Now, you have told a lot of gloomy stories and so did the engineers before you. The question is, are there success stories, leaving aside the great success of the British pharmaceutical industry? Are there success stories where you believe that British inventions have been properly exploited in this country and have led to great commercial advantage?

(*Professor Horlock*) I would like to say something which I have said to your Committee before, I think, my Lord Chairman, that there are some excellent examples of co-operation between universities and industry in this country, and I think the pharmaceutical area is one. I do not necessary concentrate on inventions because, as an engineer, I think in terms of design and development as well. Looking at the Rolls Royce link with their centres of excellence, particularly the Whittle Lab, the co-operation is excellent. It is very difficult to tell in that laboratory who is a research student and who works for Rolls Royce. It is an integrated team; it feeds directly into the design of the engines. It seems to me it is examples like that which we have to build on. Perhaps we spend too much time picking up the negative aspects rather than the positive ones. It may well be that the pharmaceutical industry has a comparable experience of that.

(*Dr Iversen*) You asked us not to talk about pharmaceuticals, my Lord Chairman, but I think one area where I see grounds for optimism is in the start-up companies in the biotechnology area where it is very good to see in the last few years the number of small companies being floated on British ideas, with British venture capital at last. I think that is a very helpful sign and looks as if it will gather momentum.

(*Dr Young*) I am sorry to sound quite as negative as that. I think one of the major engineering success stories was the magnet, indeed the whole of MR where, even though we have a habit of losing the bottom end of the market (where people make 300 MHz when we are making 500, or 400 MHz when we are making 600) I think on the whole we have kept, over many years now, a pre-eminence in this area and in the whole of the cryogenic material infrastructure; the low temperature activity work is as good as any in the world.

637. Do you have any comments, other than those we have already heard from the engineers, about the recruitment of overseas students?

(*Professor Horlock*) I think perhaps I may have a prejudiced view. I do not think that the really good groups have difficulties in recruiting students at all. Again, from my own experience, we get many, many applications from overseas and we choose between them to get the very best. I think the Royal Society does its bit by funding the professors and the university research fellows, and it is a quality which attracts those students in. There is, of course, the fee aspect, and many of the better groups have to get research contracts in order to fund the students, and the fees.

638. Thank you very much indeed for coming.

(*Professor Horlock*) I do not think I gave Lord Selborne an adequate answer on the large research projects. I would just say that Dr Pease, who directed the JET project, is very strong on this. He says that an essential feature of establishing these international projects is the convincing, whole-hearted and financially realistic support by Government of the host country. I think I should, on his behalf, emphasise that aspect.

Chairman] Thank you very much indeed.

WEDNESDAY 22 JUNE 1994

Present:

Nelson of Stafford, L.
Perry of Southwark, B.
Perry of Walton, L.
Porter of Luddenham, L.
Selborne, E.
Walton of Detchant, L. (Chairman)

Letter from Northern Telecom

As we discussed on the telephone I am co-ordinating our company response to your letter to our Mr Ball of Northern Telecom, in February. This initial response covers the four questions in your covering letter and I shall write at greater length shortly on your longer questions.

Question 1: Scale and Nature of our R&D Operation

Northern Telecom is a company with operations world-wide, employing about 57,000 people with its headquarters in Canada, and is one of the world's leading suppliers of digital telecommunications switching equipment. The Company operates a research and development subsidiary, called BNR. The BNR headquarters are in Ottawa, Canada, and there are nearly 10,000 BNR employees in total world-wide.

Northern Telecom employs just over 7,000 in the United Kingdom out of 9,000 plus in Europe, of which BNR has about 1,500 employees in the United Kingdom at four locations.

BNR Europe carries out research and product development for Northern Telecom (NT). Principal areas of R&D include public and private switching, terminals, networks, transmission and access, wireless, and a wide range of other telecommunications and technology topics. The Company also operates manufacturing operations in Northern Ireland, South Wales, Paignton and other locations.

BNR Europe is one of the top ten largest R&D organisations in the UK and is in the top group of graduate employers in the industry.

Question 2: The history of NT and BNR's involvement in UK science

NT and BNR and, prior to 1991, STC (which was purchased by NT in 1991, becoming part of NT Europe) has a long and distinguished history of collaboration and involvement with the UK science base. In the last 15 years, for example, the Company has taken an active part in Alvey, ESPRIT, RACE, LINK, JOERS and other UK Government and European Community programmes. The Company has sponsored many hundreds of students through their undergraduate and postgraduate careers and has been a major employer of graduates in all the scientific disciplines for many years. Over the last three years we have taken on about 400 graduates which bears comparison with any other large company in our sector. In addition, the Company has had close involvement with undergraduate programmes in many universities through provision of many graduate and undergraduate projects and has a major global programme of university interaction of which the European and UK External Research programme are but a part.

Question 3: Relations of the company with UK academic science

The Company has extensive relationships with the science base. A number of the staff hold visiting professorships and lectureships in UK universities, and take part in advisory boards as well as course work and examinations. There are extensive numbers of CASE and CAST awards. The Company takes part in a number of Teaching Company programmes with a number of universities. As part of its global university interaction (External Research) programme the Company spends over $1 million in grants to universities in the UK, including support of chairs, both individually, and jointly with the Royal Academy of Engineering, support of individual researchers in many universities, and donation of equipment. In addition, many of the Company's senior staff have served on, or are serving on, committees of the SERC and of the European Community associated with the science base. Several of the executives are involved with the Foresight exercise with the Office of Science and Technology in various capacities. In addition to all of this the Company sponsors a number of universities to give courses at Company locations and sponsors its own staff to take extra degrees up to, and including, PhD.

Besides this involvement with the university sector directly NT and BNR have established close relations with schools in all the local areas where the Company operates. In the south-east of England we work with, for example, Verulam in St. Albans, and Stewards in Harlow. In Northern Ireland we have purchased a large number of optoelectronic demonstration kits which we lend out to many schools to help them with their science curriculum, and we work especially closely with Rathcoole High, which is adjacent to our Northern Ireland plant. Our school relationships, of which these are but a few examples, have helped stimulate great

interest in both engineering and telecommunications. One measure of the success of our relationships with our schools is their success in national competitions.

In 1993–94 Northern Telecom sponsored the Faraday Lecture, an annual presentation held in more than 20 cities in co-operation with the IEE, aimed especially at schools and colleges. This lecture was widely acclaimed. The presentation at the Barbican in London was simultaneously transmitted by satellite to Canada and carried on a cable broadcast network. It was also presented in New Zealand by video. The lecture has been video-recorded by the BBC and copies have been distributed widely to schools. Dr. Alan Rudge, President of the IEE and Chairman of the EPSRC, gave great praise to Northern Telecom for the Faraday Lecture Programme.

In summary, Northern Telecom and BNR have a long history of deep involvement with, and practical support of, the UK science base from schools to universities through provision of funds, taking part in joint programmes and the use of extensive amounts of time of its senior engineering staff.

In addition to all the above, BNR has recently formed a new organisation reflecting NT's global position. NT's new World Trade organisation, dealing with all sales and marketing outside the Americas, is now based in London; BNR's President, George Smyth, has moved from Canada to London to head the new BNR World Trade organisation. The UK is therefore in a pivotal position for the company, and our excellent and mutually beneficial relations with the UK and European science base form a crucial part of our strategy for long term growth.

It is my personal opinion that the excellent work being done in cooperation with the British science base, by laboratories such as our own, enhances the capabilities of the science and engineering base in the UK and the rest of Europe.

Prof. Daniel V. McCaughan, OBE, PhD, DSc, FEng,

Director, External Research

Examination of witnesses

MRS JANIS FAWN, Group Director, NT, MR DAVID BALL, Managing Director, Switching, Northern Telecom Europe Ltd, and DR DANIEL MCCAUGHAN, Director External Research, BNR Europe Limited, were called in and examined.

Chairman

639. Thank you very much Mrs Fawn, Dr McCaughan and Mr Ball for coming to see us. Would it be your wish to make an opening statement to explain or to amplify what has been set out in your paper?

(*Dr McCaughan*) Yes.

640. It would. Can I then just ask you, right at the very beginning, I could not see it in the papers, I may have missed it, what does BNR stand for?

(*Dr McCaughan*) The slight complication is that outside the North American continent BNR stands for BNR because of historical reasons to do with the anti-trust division between ATT and ITT way back. In Canada it is Bell Northern Research.

641. Bell Northern Research.

(*Dr McCaughan*) But formally it is BNR.

642. I just wanted to be clear on that If you care to make your opening statement we would be very interested to hear it.

(*Dr McCaughan*) My Lord, we would like to have Mrs Fawn introduce the company for you and to give you a few slides on the company itself. Then I will show you some slides about the research and development aspects of the corporation. Then Mr Ball will speak after that, at an appropriate point, on the relationships with our research and development worldwide.

Chairman] Right.

Lord Nelson of Stafford

643. Could I just ask one question before we start, my Lord Chairman? Knowing a little bit about the history of your company, I do not know whether you can bring it out now or would you like to say something about it later, but I wonder how much of the research and development international and national is a left-over from the past and how much is relative to the future? I can imagine probably there have been some considerable changes since Northern Telecom took over from STC?

(*Dr McCaughan*) The company has some elements of its research and development in the maintenance of current equipment, some elements in the development of advanced equipment. We have over 10,000 people worldwide; most of them are working on the evolution of new products and forward looking research and development.

644. Are they free standing programmes or are they co-ordinated programmes across the whole group?

(*Dr McCaughan*) It is very much a co-ordinated programme. We are funded through the Northern Telecom business by what we call matrix funding.

645. Northern Telecom in Canada?

(*Dr McCaughan*) Yes. BNR is the research company and Mrs Fawn will illustrate that in her slides. I think probably it will come out fairly clearly then.

646. That is Canadian based?

(*Dr McCaughan*) The company is a multi-national which has grown out of Canada. It was based

[Lord Nelson of Stafford *contd.*]

originally in Canada but it has now got many operations worldwide.

Chairman

647. Thank you. Mrs Fawn, do you want to start?

(*Mrs Fawn*) My Lord Chairman, good morning. If I can talk first about the tri-corporate family—I think that does explain the question you asked initially: where did the BNR come from. It is put together by both Northern Telecom and Bell Canada. I think that it is a very powerful combination because we have the research, we have the manufacturing on the Northern Telecom side and Bell Canada as an operating telco in Canada covering basically Ontario and Quebec so that gives us an opportunity to really get a lot of information in terms of what the end users need. We can feed that back through our Bell Northern Research and through the manufacturing arm. Northern Telecom itself will be 100 years old next year. We are very much a global organisation. *This* slide gives you an idea in terms of the size and the scope: sales of 8.1 billion—that is in American dollars, the revenues line. We have 57,000 employees all over the globe. We are the fourth largest global telecommunications company. We do research in eight different BNR sites and 25 Northern Telecom facilities for manufacturing. Approximately 11 per cent of that top line of revenue is spent in research and development, and we are investing to stay ahead. In terms of Northern Telecom world trade, *this* slide shows the scope of the operation outside of North America. We have to address 200 countries, 2,000 languages, 21 time zones, 78 per cent of the world's population, 75 per cent of the telecomms market itself and 66 per cent of the world's gross domestic product. Our world trade organisation is headquartered here in London and London to us is very strategic. England is our most strategic market outside of North America. NT World Trade is headquartered in London as one of the easiest things to do is actually communicate from here. We are trying to save on travel, both because of the expense of doing it but also because of the disruption in people's lives when they have to travel so much to far parts of the globe, so we do try to have a lot of our meetings by tele-conference or video-conference. You can chair those meetings from London as you are only five hours away from the east coast of North America and eight or nine hours away from Singapore or Japan, so it is an excellent place to actually have your headquarters for that reason alone. We have 11,000 employees in Europe and manufacturing plants in the United Kingdom, (I will show those in a moment) in France, in Ireland, in Turkey. R&D facilities are very significant in these locations and Dr McCaughan will expand on those in a few minutes. We do have joint ventures and we do have distribution partners. (This material by the way is in the hand-out). Why are we in the United Kingdom? Our acquisition of STC, the final acquisition in 1991, gave us a tremendous base, both the very advanced and widely reputed labs at Harlow and also the tremendous human resource potential that we picked up when we got STC. That can be deployed in all different parts of our global operation. The United Kingdom is very liberalised, one of the most liberalised markets. This is the opportunity to learn in the United Kingdom with all kinds of new operators: cable operators, 'ENERGIS' etc; a few well known others have come along and we are working with all of them. The competition is extremely aggressive and the United Kingdom is heping to create liberalisation all over the world, we believe. To give you an idea of the locations that we have, in the United Kingdom: there is New Southgate, which is North London, Harlow, London itself, Paignton on the coast, Cwmcarn in Wales, Maidenhead (a very significant employee population in Maidenhead) and Monkstown in Northern Ireland. We have 11,000 staff as I showed before and they are scattered through BNR and R&D facilities that include all of those locations. We also have staff in France, Germany and, of course, the Republic of Ireland in Galway. I believe you had a question in terms of are we building on those and are we investing. Just to show you an example of investment in those locations: from 1992 to 1994, these are the kinds of monies that we are putting in, about £72 million upgrading those manufacturing facilities and adding another factory site down in Newport Wales last year. I will turn over now to my colleague, Dr McCaughan, thank you.

(*Dr McCaughan*) Chairman, we are very happy that either you could ask questions immediately of Mrs Fawn or if you like we can show you the other few things we have to show you first and then ask us all questions afterwards, whatever suits you best.

Chairman] Some of the questions which we circulated to you have been answered by that introduction. Can I just follow up on what Lord Nelson asked and by enquiring how great a part of your United Kingdom research operation came to you through the acquisition of STC?

Lord Perry of Walton] Could I ask what is STC?

648. Standard Telephone & Cables.

(*Dr McCaughan*) That was the original company, that is right. STC had labs in Harlow in Essex and had some development work in New Southgate and a small amount in Basildon, also the operation that I was at that time responsible for in Northern Ireland had about 150 people, the total I suppose would have been 1,200 or so development and research people all together, it is now 1,500.

649. As a percentage of your total operation?

(*Dr McCaughan*) Of the total of Northern Telecom—

650. Total research operation.

(*Dr McCaughan*) BNR, it is about 10,000 people and there are 1,500 in the European operation, approximately.

651. How much of your research is conducted in Northern Ireland? I saw that the Monkstown site employs 169 people?

(*Dr McCaughan*) That is correct. In fact, if you add in a few other engineers that we have on contract there are roughly 200 people working out of the roughly 1,500 or so in the United Kingdom.

652. Do you regard Northern Ireland as being a good environment?

[Chairman *contd.*]

(*Dr McCaughan*) Yes. It has been a very productive environment for us, both a low cost environment and a very productive environment from the viewpoint of availability of good graduates out of the two universities.

Lord Nelson of Stafford

653. Could I ask, bearing in mind the history referred to earlier on, what is it that decides where you do your research, part of it must be history and the fact you have got the people. Our terms of reference are international investment.

(*Dr McCaughan*) Indeed.

654. Some of yours is international investment and some is not in a way.

(*Dr McCaughan*) May I answer that indirectly by perhaps showing you a couple of slides which address that issue and Mr Ball, in fact, will be addressing that issue also specifically.

Chairman

655. I think we should hear you because it may be that other questions we have set out in the paper will be answered by what you say.

(*Dr McCaughan*) I hope so. First of all, let me explain that we have a very large worldwide network of R&D facilities, because we have got development facilities not just in BNR, which is the research company, but also in many of our Northern Telecom sites, our manufacturing sites and so on. We have a very large network of R&D labs. We also have manufacturing operations: we have already mentioned the ones in the United Kingdom but we also have manufacturing in all of these other locations worldwide as well. In order to connect all those together we have a corporate communications network which in fact spans the globe. As you can see, on the slide the captive offices are where we have equipment which is duplicating or replicating that which we put out to our customers; there you can see we have 11,000 work stations, over a million megabytes per month of data gets transferred around the company. We very much use our international data network, and our international video-conferencing network as a part of the way of life of our operation. After this meeting today I am going to a BNR world trade meeting where our operations in China, Japan, Canada, Harlow, here in London and over in Europe—continental Europe—will all be connected by video for an hour's video conference. You asked some very specific questions of how we link with academia and I would like to tell you a little bit about that. We, in fact, have an education and research programme, it goes under various names such as EARN, Education And Research Network, and External Research which you will see more accurately on the slides. We have a large programme which was started by Northern Telecom in Canada and the United States before the acquisition of STC. STC also had a lot of programmes and they have all been amalgamated together into one large worldwide university programme where we spend just over ten million dollars a year, that is extra over our internal R&D spend, in universities. Of that we spent just over $1 million, in Europe last year, a very large fraction of that in the United Kingdom. I am going to show you some details of the kind of activities that we do with that. We fund specific research projects, sometimes that is general contract research programmes and sometimes very specific; sometimes we give grants for a long-term research programme but we are not actually looking for a specific result, we are just funding the programme. We have Chairs that we fund. We have an NT Chair in photonics in Cambridge. There are two new chairs that we have just started this year together with the Royal Academy of Engineering. We have one Chair in communication systems at Queen's Belfast and a new Chair in telecommunications and marketing, trying to bring together the business and technical aspects, at Imperial College London. We arrange for people we fund to visit the United States and they visit our labs in Canada and China and so on. We support people from countries in the CIS, for example, on short research secondments in universities. For example, there is a Czechoslovakian academic who will soon be coming over and be supported for six months shortly. We supported a Chinese gentleman through his whole Cambridge studies in business. We provide funds for sabbaticals and we are of course very tied up with our—

Lord Nelson of Stafford

656. Will you tell us then why you go to particular countries for particular research? Is there a formula?

(*Dr McCaughan*) Yes. There is not a formula *per se* but as Mr Ball is going to address you very directly, where we operate we usually try to have research and development, and that is one of the very major issues in the world at the moment.

Lord Porter of Luddenham

657. Are the chairs that you fund just university chairs or do they actually retain a connection with the company?

(*Dr McCaughan*) The way that it works, for example, in both Canada though NSERC Committee, a Government organisation, and here with the Royal Academy, is that we guarantee funding jointly with the Royal Academy for five years and the university guarantees to take on the Chair. The individual is a full member of staff of the university and is under no specific obligation to us. Our hope would be, and very often is, that the person would also be a consultant to us as well and that would be a separate agreement between ourselves and the professor. It is not a condition of the case.

658. I noticed in your statement the Royal Academy was mentioned: why the Royal Academy? This is largely, on the whole, humanity and the arts support, is it not, why not the Royal Society?

(*Dr McCaughan*) The Royal Academy of Engineering, as I am sure you are fully aware, has a programme of joint support for chairs.

659. You are talking about the Royal Academy of Engineering?

(*Dr McCaughan*) Yes.

[Lord Porter of Luddenham *contd.*]

660. I am sorry, I was thinking you were talking about the British Academy.
(*Dr McCaughan*) No.

Chairman

661. You persuaded the universities to accept these on a five year basis with an agreement to take over?
(*Dr McCaughan*) Yes.

662. That is something which I thought had almost disappeared in this country over the last few years.
(*Dr McCaughan*) We had a very positive view on this both from Queen's Belfast and from Imperial College. Of course, we have another chair which is not funded with the Royal Academy of Engineering, but with the Newton Trust in Cambridge in Photonics; we pay most of the cost.

663. As we are talking about your links with universities, we are becoming much more aware nowadays of the full cost of intellectual property. In negotiating contracts do you feel that their expectations are reasonable or over-ambitious? Do you feel that what they expect of you in relation to overheads is reasonable?
(*Dr McCaughan*) Let me address that in two ways. There are one or two issues with one university that I would really rather not get into at the moment but in general the experience that we have worldwide, and our approach worldwide, has tended to be to look for effectively royalty-free exploitation of intellectual property which comes out as a result of the work that we pay for, but the university would have the intellectual property rights and would also have the right to use and explore, for its own purposes, those results. That has been our practice worldwide and it seems to have worked fairly well. We have one or two minor issues at the moment but in general it has worked out very well. I do think universities are very aware of these issues now and the overhead issue is one that I have always been very aware of through the Technology Board for Northern Ireland. When I chaired that, I was always very concerned that universities did not get enough overheads from many of the grants that they were getting. It is quite important that they have an adequate level. This slide shows our mission. Effectively we are trying to access leading edge thinking and research at universities. We try to go to universities which are well rated, but we also have links sometimes with universities that are physically very close to our plants. For instance, at Plymouth, we have links with Plymouth (which is not a top flight university) but it is very close to our plant at Paignton so we do things with them in recruitment, and working with them. We also tend to go to University College London, Imperial College, Cambridge and so on. I have got a chart for you in the back of the documents that I gave you which shows more or less our entire European programme. In Cambridge, for example, we support a chair of opto-electronics. We also support semi-conductor materials and opto-electronic work under Professor Carroll in the Electrical Engineering Department. That is just a research grant, we do not put any conditions on it. We have a joint programme with the Manufacturing Engineering Department, with Mr Gregory from manufacturing engineering. We have also just provided a small grant to Professor Needham—I am sure you are all aware of Professor Needham—who is working in ATM networks and telecommunications networks.

664. What is ATM?

(*Dr McCaughan*) Sorry, asynchronous transfer mode, is one of the buzzwords in High band width communications. Professor Roger Needham has been a star in this field for a long time, so we provided him with some money this year, and he is working with the Newton Trust. He wants to try and set up a new centre and we are helping him to try and fund that. I'd like to give you a few examples of other things both locally and abroad. For instance, in the University of Hertfordshire they have done some interesting work on neural networks and are working with our switching programme to look in the huge software that exists we have in a telecommunications switch. They have developed a technique which allows us to pick up what we call "clones"; which is where you use a piece of software once, pick it up and use it somewhere else, and repeatedly. When you go back and find that there is a bug you have to trace all the "clones" back. They have developed some interesting clone detection methods and we are working with them on that. This is an interesting example: Carlton University, close to our Ottawa labs, we have a sort of hot line arrangement with them. We have distinguished speaker presentations where we invite some of the people we work with to broadcast worldwide on our network. We have all our staff come into the lecture theatres where the video is so that we can actually have lecture presentations. You asked about Northern Ireland, let me just give you one short, brief slide on Northern Ireland. We sponsor in Northern Ireland roughly 12 students a year. We have a whole set of post-graduate CASE-CAST awards—CAST is the Northern Ireland equivalent of CASE - in a number of universities including Edinburgh, Queen's and the University of Ulster. We have taken part in DTI programmes. One of the other interesting things is we define the final year under-graduate programmes for them—we give them projects to work with and often we give them a piece of equipment to work on the project. We work with Teaching Company Schemes—we have taken part in two or three different teaching company schemes. We support our own staff to do extra degrees. We have supported 24 staff in BSc, MSc, PhDs, (that is out of 150) so that is quite a high percentage. We have close links with schools. For example, we have bought opto-electronics kits, which cost about £1,000 a time and we bought about 14 of these. We put an advert into the Northern Ireland schools' magazine for 250 grammar schools, so that they can basically queue up and borrow them for a month or two months at a time, so pupils have a good example of how to work with opto-electronics. We did the Faraday Lecture this year with the IEE, and we got a joint STRIDE programme that is the European regional programme with Northern Ireland, with the University of Dublin, and Queen's Belfast.

Lord Nelson of Stafford

665. Is there a programme specific to Northern Ireland?

(*Dr McCaughan*) There are similar things but that is a regional fund rather than a framework-type programme. That one is specific to peripheral regions and Northern Ireland had some extra money left. We set up a joint centre with the two universities. I do not expect you to read all of this slide here, my Lord, but I have broken down a list here of all the various things that we do. These are just the programmes that we currently have including Chairs and Consortia. A word that may puzzle you is "Window". What we mean by that is we give the university a grant as a "window" for us into their research. So the codeword on our database is "Window". We support students, we are members of consortia and sometimes we have contact research to do a specific project with short-term deliverables. In that case if we are looking for a particular deliverable, we would fund that 100 per cent and we would normally expect to wholly own the intellectual property rights in that case.

Chairman

666. I suppose it would not be possible for you easily to give us even a rough figure as to what proportion of your expenditure on R&D in the United Kingdom is generated by the parent company in Canada and what proportion is generated in the United Kingdom?

(*Mr Ball*) Most of the R&D done in the United Kingdom is for the global corporation. We tend to have centres of excellence concentrated on a particular kind of technology or aspects of the markets and in that sense the R&D carried out in a particular place would be for all Northern Telecom's operations worldwide, hence a considerable percentage, would be for use outside the United Kingdom. As an example we have set up a new Broadband Lab in Harlow which I am going to address later. Secondly, one of the major new growth areas in our kind of business is transmission. STC was quintessentially a transmission company and most of the R&D for transmission takes place here in the United Kingdom, although there is also some in North America.

667. You identified for us some centres of excellence into which you are putting some R&D investment in universities and elsewhere. Is there increasing competition from elsewhere in Europe? Have you felt any concern about any evidence coming to you about the quality of our science graduates or any evidence relating to the erosion of the United Kingdom science base in universities?

(*Mr Ball*) What I would like to do is perhaps take you through the presentation that I was going to make because I am addressing very specifically the issues of competition from various countries around the world for R&D investment. I have a United Kingdom citizen's hat for half of this and a Northern Telecom hat on for the other half. Would it be appropriate for me to do that?

668. Yes, please.

(*Mr Ball*) I do not have any slides but I have produced some text so I will talk to that if I may. Professor McCaughan has told you about the investments we are making in the United Kingdom and I want to tell you why we make them here and perhaps some of the other issues we face in reaching such a decision. You have seen that Northern Telecom is a very substantial company, and it is a global company, it is making substantial R&D investments outside its base in North America. I sit on the Boards of a number of our European joint ventures and I would like to tell you about some of the considerations, perhaps pressures, that we face in making decisions about where to site our R&D investment. Ten years ago the considerations of where to site R&D would have been largely based around considerations of cost, availability of skills, environmental factors, critical mass and closeness to market. Those criteria are still important but they are not the only ones. The physical location of R&D facilities has now become a major strategic issue for all global corporations, particularly when they are entering new markets. Put very simply, the siting of an R&D facility in a country which a corporation wishes to enter is becoming a key "table stake". I would like to give you some examples about our moves into Europe if I may by sketching a little background. Our experience has been that it is not possible for a non-indigenous supplier in this business to establish a core position in a new market until reregulation occurs. As your Lordships will be aware, the European Union has imminent reregulation plans for telecommunications. At the same time we are seeing major opportunities in Eastern Europe following the break up of the Soviet system, and in the developing countries in Asia and Africa. For most of these markets, both developed and developing, our common experience is that a supplier will find it very difficult to be successful unless he is prepared to make a major investment in high technology manufacture and R&D. I would say that despite the regulations in Brussels on open tendering, this can be as true for countries in the European Union as it is for developing markets. A few years ago, the "table-stakes" were manufacture, but countries now are no longer interested in what is colloquially called "screwdriver" plants or low tech assembly. By way of illustration I would like to show our investment in Turkey where we employ 2,000 people in an operation which was founded in 1967. I happen to be the Chairman of this company. In March this year, Mr Demirel, the President of Turkey opened an extension to our new R&D facility. In his public address he specifically cited Northern Telecom as the kind of company that Turkey needed and for the following reasons: it brought major investment to Turkey (which it certainly does); it creates jobs; it is a major exporter but the most important thing of all was that it created high technology expertise in Turkey. Now I think it is true to say that this requirement is the same for almost every country in which we want to operate. Companies operating in telecommunications supply, and information technology face a surfeit of opportunities. We cannot afford to be everywhere geographically doing everything at once because our resources will not stretch to it. So companies such as our's are faced with a strategic investment decision about where we should put our R&D for competing opportunities. We simply cannot afford to put our R&D facilities in every country in which we would hope to establish a significant presence. So in choosing the countries in which we wish to invest, we

[Chairman *contd.*]

would certainly look at the criteria of skill availability, university research programmes and the various synergies but this would be against the background of the size of the opportunity in the country and the return that we would get for making that investment. Now you know that in the United Kingdom we have a very substantial stake in R&D and some of that is historic from our acquisition of STC, indeed that acquisition was made for very specific reasons by the Corporation in its drive to become global. Since that acquisition there has been an increasing investment in R&D in the United Kingdom and that is precisely because of the opportunities that we see here and the leverage that we can get from what we do here. We recently set up our new Broadband Laboratory in Harlow. As your Lordships are probably aware, Broadband, along with Mobility, is one of the major global drivers in telecommunications, so why site it here in the United Kingdom when we could site it anywhere? Let me say why. Janis Fawn alluded to this in her presentation. The United Kingdom is the lead country in reregulation; quite simply there is an enormous experiment in telecommunications going on in a particular "laboratory" which is called the United Kingdom. It is creating major new markets for cable television and for the new operators who are seeking to use that Broadband technology. We feel that this is the place to be, if you want to learn the new lessons about this sector. I am going to deviate from my text to say very briefly that the changes taking place in global telecommunications, in information technology and the collision of those technologies are huge. All the paradigms that we have known in the past are changing. There are a lot of gurus who write lots of articles in business reviews about what the future will be but I do not think anybody really knows. Every important supplier and every important telecommunications company is looking at the United Kingdom to see what is going to be the future. So this is the place to be if you want to learn the new lessons, lessons that are going to be applied as deregulation takes place in North America and Europe. There was, and there is, fierce competition, not only within our own Northern Telecom European operation to site R&D facilities in other countries but also from other Northern Telecom regions in Asia Pacific, Latin America and in our base in North America itself. We chose the United Kingdom because of this learning experience, and because we can become established and establish our credentials with the new operators. It is for this reason as much as the more obvious ones that are usually advanced for making such a decision that caused us to make this extra investment. Now I would like to make another point—this is also with my United Kingdom citizen hat on—the Committee is probably already aware that R&D of this kind, which is software based, is very portable. Today it is possible to have R&D laboratories sited in different parts of the world in communication with each other using the very technological skills or links which they themselves are developing. Professor McCaughan talked about the way in which all our laboratories are linked in that way. There are also trained skills available in countries such as India and Vietnam at a fraction of the costs in the United Kingdom and perhaps the best example of this is in the CIS following the break up of the Soviet Union where lots of skills are available at fairly low cost. I would like to summarise by saying that our R&D investment as a corporation will follow market opportunity and cost factors assuming that the skill base and the environment are also present. The point is that the skill base and the environmental factors are becoming more ubiquitous in which case opportunity and cost become more important. Our new investment in R&D in the United Kingdom is based both upon the learning opportunity and the skill base being here present in what we feel is a unique situation in the United Kingdom in telecoms at this time. In conclusion I would say that we are investing or increasing our investment in R&D in the United Kingdom because for us the United Kingdom can compete with other countries in attracting that investment, so there is not an altruistic view of this. I hope I have been able to explain why and how that experience might be relevant to your deliberations. Thank you.

669. You said in your evidence that over the last 20 years indigenous United Kingdom industrial R&D and telecommunications has declined leaving a gap to be filled by foreign companies including your own. Which British companies have shown a decline in R&D in this field?

(*Dr McCaughan*) My Lord, far be it from me to criticise other companies.

670. Exactly.

(*Dr McCaughan*) May I really suggest that if you were to look, for example, at the R&D which was funded by Government such as through the Alvey programme, which very much impacted into this sector, I think it is probably true to say that United Kingdom companies have not replaced the funds that disappeared as a result of the ending of that programme with extra funds of their own, and that the numbers of people in a number of labs have declined. I think it would probably be more appropriate if your Lordships were to ask those companies directly rather than us.

671. We appreciate that.

(*Dr McCaughan*) All I can say, however, is if you do look around the United Kingdom, there have been significant investments by ourselves, by IBM, Hewlett Packard, companies which were originally based outside the United Kingdom and also component companies like NEC and Fujitsu. There has been a lot of investment into the United Kingdom which I think has been very beneficial.

672. If you are number four in the world, who are numbers one, two and three?

(*Dr McCaughan*) The number one is AT&T, then Alcatel and Siemens.

673. One thing that puzzled me in one of the slides that was shown by Mrs Fawn "200 countries, 2,000 languages ..." etc. "75% of the world's telecom equipment market".

(*Dr McCaughan*) Yes.

674. What does that mean? What does "66% of world's Gross Domestic Product" mean, I was puzzled by what you meant by that?

[Chairman *contd.*]

(*Dr McCaughan*) My Lord, it is because we are a North American company and we tend to bandy those figures around inside our own corporation to point out that actually most of the action is taking place outside of North America.

675. I see. What is the significance of that 66 per cent of world's gross domestic product?

(*Dr McCaughan*) My Lord Chairman, most of the growth in telecommunications is outside the North American continent. We have very large groups in very large markets like China, countries of the Far East—

Baroness Perry of Southwark

676. Describing your market?

(*Dr McCaughan*) That is right.

Baroness Perry of Southwark] It sounded as if it were your own share.

Chairman

677. Exactly.

(*Dr McCaughan*) We are a big company but not that big!

678. This is the market to which you have access?

(*Dr McCaughan*) That is correct.

Lord Porter of Luddenham

679. Even so, 66 per cent of what market? Are you saying 66 per cent of the total world market is in the field of telecommunications?

(*Dr McCaughan*) No, no.

680. What is the 66 per cent, of what?

(*Dr McCaughan*) Of the total world GDP is outside the North American continent, and 75 per cent of the world's telecommunication equipment market is outside. As Mr Ball says, our company, started from the North American continent; one of the reasons for the growth of Northern Telecom was that Northern Telecom had a product which was exactly suited to the North American market at a time when the North American market became in effect deregulated when Regional Bell Operating Companies all separated. So there was very rapid growth over a number of years.

(*Mr Ball*) I think in the context of your deliberations, my Lord, it is because Northern Telecom has to become a global company. No company in this field can survive without becoming global. We are moving out of our North American base and these strategic decisions have to be made about where we make the investment. It happened that the first major strategic decision was to come into the United Kingdom by buying STC and as a result of that a lot of additional investment has come into the United Kingdom, particularly in R&D. We now have lots of competing requests to make investments elsewhere. We are making huge investments in China, for example. Asia Pacific itself is making huge demands for investments. The Eastern European countries are making huge demands on the investments. With deregulation coming in Europe in 1998 in our industry we are looking at a number of activities in continental Europe and for every single one of them the table stakes are R&D. That is the real point I wanted to get across. Therefore, the United Kingdom is in a competition with other countries for R&D, there is absolutely no question about that, and therefore the experience of why we chose to invest here I thought was interesting.

Chairman

681. That is very helpful. Just one more question: if the rest of Europe and North America deregulate to the extent that you say that the United Kingdom already has, is it likely that you will continue with your operation to the same extent in the United Kingdom?

(*Mr Ball*) I would like to think about that. The answer is I do not know. I put a note in here to say that R&D of this kind, is very portable—it is possible to move it around. I think it is unlikely, because you build large critical masses of people with bases of knowledge, that are not that easy to transport somewhere else. I think maybe there is a lesson there about being first, and getting the critical mass in place, and then perhaps it is more difficult to transport it without throwing out the baby with the bath water!

(*Dr McCaughan*) May I add something to that, which is that of course our ambition in the environment which you describe would be to grow. We would find it both advantageous and necessary to continue at the same level of R&D spend, and therefore we could see growth happening in other places.

Lord Porter of Luddenham

682. When you are looking at the availability in different countries, at the skills base that you need to set up a research organisation, what are the skills that you are particularly looking for? Are they mainly in engineering, electrical engineering?

(*Dr McCaughan*) Yes.

683. What sort of research are they mainly going to be doing? Is it medium term almost entirely, is there any blue skies research, or is there a tendency to go short term?

(*Dr McCaughan*) May I cite, in answer to your question, our experience in Northern Ireland which I think is pretty powerful. We had a factory in Northern Ireland which had a relatively small amount of advanced engineering, associated with it. The relatively small amount of products that were being made were relatively simple in our industry terms. We decided to set up a new engineering centre and the skill base that we looked for included skills in software, skills in mechanical engineering, skills in electronic hardware. We hired the people with those disciplines but we also hired physicists as well. We did not hire material scientists or chemists because it was not really appropriate to do that. The work which was done initially was all what we would call short or medium term product development, but we also encouraged a few of the people to take part with the universities locally in longer term programmes by sponsoring R&D programmes in the universities and working with them. That has grown. I would anticipate that over the next five years in the

[Lord Porter of Luddenham *contd.*]

Northern Ireland environment that aspect will grow to tie it in through, for example, the STRIDE Project which is a centre for advanced testability. It is what the Japanese would call "basic applied research" rather than being "basic basic research" in Japanese terms.

Baroness Perry of Southwark

684. Just a quick question. I wonder if you could expand very briefly on your "windows" strategy which I think is one we have not heard about before. Could you just tell us how it works? You pay a university a sum of money in return for which you could look at what they are doing in any aspect of research, presumably not funded by other industrial companies?

(*Dr McCaughan*) No. The term initially came out of the Canadian based programme. We have just stuck with the term because it is one that they have used. What in effect it is shorthand for, is giving a research grant to a university department. That normally would be a research grant which in our own terms would not be very much different from an SERC type grant, where the university would make a proposal to us and say: "We have got an interesting idea we would like to pursue." It is very much like an SERC proposal. Some of the things we have done have been quite long term. For instance, we funded a programme on surface plasmons, looking at surface plasmons as possible detectors for photons, with the view that in maybe 15 years' time it might give us some kind of new detectors for our optical fibre devices. It really was a very long shot. That is an example of the kind of "window" research. In Cambridge we provide funds to John Carrol's department of electrical engineering amounting to about £25,000 a year, in addition to the fact that we fund the professorship. Basically, we then have contact with the university and see the kind of research they do. We visit them and talk about the research. Sometimes they will come to us and say, "We have another idea that we would like to think about funding". It also gives us an opportunity to go with the universities jointly into some of the EC programmes. That is what we mean by "windows".

Earl of Selborne

685. I was interested in the encouragement that you were giving to your staff to obtain various qualifications, from first degrees to PhD and the like. Perhaps you would like to comment on the product of our educational system in this country and its ability to meet your requirèments compared with, say, our European competitors and the Far East?

(*Dr McCaughan*) In my view, the United Kingdom still has a good system, and we get some very good people from some of the better universities. All companies compete very heavily for those people. I believe that in France the *grande ecole* system, which is unashamedly elitist, provides some absolutely top class people. We are looking to work with them. As a personal view, I am afraid that I am an elitist in one sense. One should support the best and hope to make it better. One should also provide funds to keep some of the other places going and bring them up. We are continually astonished by the very high quality of people with whom we work from some of the Far Eastern countries. In India some of the software people we work with are of extremely high quality.

(*Mr Ball*) Historically, Northern Telecom has had graduates knocking on its doors to join it because of the amount of money that it spends on R&D, given that the company has that kind of ethos. In that sense, statistically one may not be seeing the correct sample since the company tends to see the cream. That applies to every country in the world. I believe that the skills that the company is able to recruit in the United Kingdom are excellent, but it is also true to say that the company can get very good skills elsewhere. The Turkish company, of which I am chairman, has 250 people in R&D. Those guys are just first class. Interestingly, Turkey is the world's R&D centre for the new switching technology used in China and other markets into which the company is moving. It has been there since 1967 and those guys do a very good job. New investment in some of the more exciting—because "esoteric" is perhaps the wrong word—areas such ATM and broadband has come to the United Kingdom. I can tell you that we have had to fight for it, and we are delighted that it has come here. We believe that this is the right place for it. But it was not just given.

(*Mrs Fawn*) We have hired over 400 graduates in the past three year in the United Kingdom and they are excellent.

(*Dr McCaughan*) That figure is comparable with that for other large companies.

Chairman: Thank you for coming and for being willing to share your experience with us.

SLIDE 1

A Global Organisation

$8.18Bn Sales in 90 Countries.
57,000 Employees Worldwide.
4th in Global Telecommunications.
Research in 8 BNR & 25 NT Facilities.
11 per cent of Revenue in R&D.
Investing to Stay Ahead.

SLIDE 2

Northern Telecom World Trade

200 countries
2000 languages
21 time zones
78 per cent of world's population
75 per cent of world's telecom equipment market
66 per cent of world's Gross Domestic Product

SLIDE 3

Northern Telecom Europe

— Europe, Middle East, Africa & CIS.
— 11,000 Employees.
— Manufacturing plants
  — UK, Ireland, France, Turkey.
— R&D
  — UK, Ireland, Germany, France, Turkey.
— Joint Ventures
  — France, Turkey, Hungary.
— Distribution Partners.

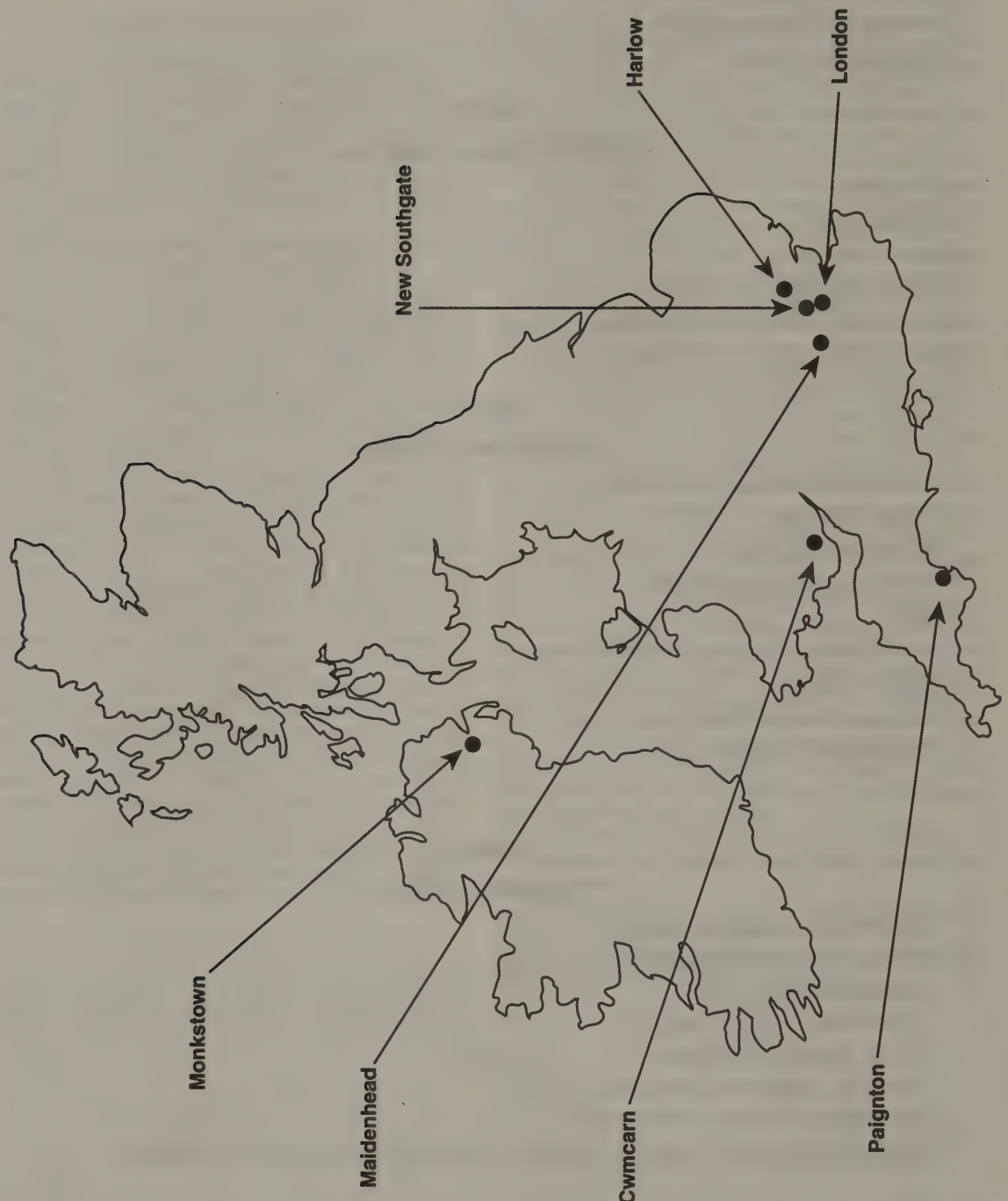
SLIDE 4

European R&D Staff

— NT/BNR Europe about 11,000 staff.
— BNR and NT R&D facilities in UK including
  — BNR Harlow 840 plus.
  — BNR New Southgate 100 plus.
  — BNR Maidenhead 350 plus.
  — BNR N. Ireland 169 (out of 900 on site).
  — NT Cwmcarn 54 (out of 700 on site).
— Additional staff in NT Germany, Republic of Ireland and France, and JV with Matra.

SLIDE 5

UK CAPABILITY



SLIDE 6

WHY IN THE UK?

— 1991 Acquisition of STC.
— Liberalised Market Since 1980s.
— New Operator Investment.
— Aggressive Competition.
— UK Creating Liberalisation Model for World Trade Markets.

SLIDE 7

NT/BNR External Research

Mission Statement

To lead and expand NT/BNR's External Research Programme by

— Accessing leading edge thinking and research at universities and elsewhere
— Exploiting external research by linking to internal programmes
— Forming joint external research programmes with key customers and industry participants
— Promoting the image of NT/BNR as employer and supplier of choice

SLIDE 8

NT/BNR External Research

University	*Programme Type*	*Main Topic*	*Project*
Cambridge	Chair	Switching	Photonic Switching
Imperial College (London)	Chair	Systems & Networks	Telecoms Strategy & Services
Queens (Belfast)	Chair	Transmission	Telecom Systems Engineering
Cambridge	Consortia	Manufacturing	Manufacturing Mobility
Salford	Consortia	Manufacturing	Solder Printing Process Modelling
Queens (Belfast)	Consortia	Software	Advanced Design for Testability
Bradford	Contract Research	Transmission	Jitter Accumulation in PLLs
IESE, Barcelona	Contract Research	Business Matters	Telecoms Investments Planning
Oxford	Contract Research	Education	Software Engineering Diploma
Queens (Belfast)	Contract Research	Software	Object Oriented Design
University of Ulster	Contract Research	Software	Reverse Software Engineering
Darmstadt	Equipment Donation	Multimedia Commns	DPN Research
Queens (Belfast)	Equipment Donation	Multimedia Commns	Video Communications
Edinburgh	Membership	Business Matters	Voice Services Standards
Imperial College (London)	Membership	Software	IC Computing Forum
Open University	Membership	Business Matters	Life Cycle Analysis—Software
Various Universities (Europe)	Membership	Education	BEST and other Databases
Various Universities (Turkey)	Membership	Relationships	General
Glasgow	Other	Education	Sponsorship of Uzbekhistan Scientist
Aston	Student Support	Devices & Materials	Optical Fibre Gratings
Brunel	Student Support	Business Matters	Life Cycle Analysis—Elect Assembly
Cambridge	Student Support	Manufacturing	Solder Joints Reliability Modelling
Loughborough	Student Support	Manufacturing	Solder Reflow Process Modelling
Manchester Metropolitan	Student Support	Business Matters	Design for Disassembly
Queens (Belfast)	Student Support	Systems & Networks	DSP Algorithms in Silicon
Queens (Belfast)	Student Support	Devices & Materials	Surface Plasmon Assisted Detectors
University College (London)	Student Support	Devices & Networks	High Speed Modulators Consultancy
University College (London)	Student Support	Systems & Networks	Advanced Optical Networks
Warwick	Student Support	Manufacturing	ORMOCER Development
York	Student Support	Wireless	CDMA for Land Mobile Radio
Various (Germany)	Student Support	Systems & Networks	Network Planning
Bath	Window	Devices & Materials	Electroabsorption Modulators
Berlin	Window	Business Matters	Marketing/Policy
Cambridge	Window	Devices & Materials	Solid State Lasers
Cambridge	Window	Systems & Networks	ATM
Glasgow	Window	Devices & Materials	Strained MQW structures
Hertfordshire	Window	Software	Clone Identification
Liverpool	Window	Transmission	Narrow Beam Antennas
Southampton	Window	Devices & Materials	Optical Fibre Amplifiers
University College (London)	Window	Devices & Materials	High Speed Modulators Readership
University College (London)	Window	Devices & Materials	High Speed Modulators Consultancy
University College (London)	Window	Systems & Networks	Optical Networks and Architecture
Various (Europe)	Window	Business Matters	Marketing/Policy
Telecom Bretagne (ENST-B)		Software	

SLIDE 9

UK Facilities Investment 1992–94

— Monkstown Manufacturing Site £31 million

— Paignton Opto-Electronics Factory £12 million

— New Southgate Transmission Site £10 million

— Cwmcarn Telephone Handset Manufacturing £14 million

— Newport new Factory Site £5.5 million

Memorandum by the Director of Olivetti Research

Ing Olivetti & Co SPA is a multinational organisation with a turnover of 5 billion dollars and is headquartered in Northern Italy. It has subsidiary operations in many countries which are mainly concerned with sales and also has research and development activities in a number of places round the world. The Corporate Research section is based in Cambridge UK and I write as Director of Corporate Research for the Company reporting to the Vice-Chairman in Italy.

A research lab was started in Cambridge by Olivetti in 1986 after they had invested in Acorn Computer (which at the time was in financial difficulty). It was clear that one of the main reasons for the technical excellence of Acorn was its location in Cambridge and hence it was decided to start a Olivetti research laboratory as well.

The laboratory has grown to about 30 full-time personnel. It costs about 2.5 million pounds to run each year and since its inception has attracted funding totalling about 13 million pounds. The research directions of the laboratory are concerned with development and use of computer and communications technologies. The emphasis is on publication and interaction with other groups world-wide rather than IPR protection and secrecy. This approach is well suited to our area which is rather more engineering oriented (make it work) rather than the pure science (Eureka).

The laboratory has strong links with the University of Cambridge and in particular the Computer Laboratory. It also has links with the Universities of Kent, Lancaster, and London. By links is meant joint research projects where part of the funding is provided by Olivetti either in cash or equipment, or the sponsorship of students. This has resulted in the UK being a pioneer in a number of new research areas.

Because of the difficulties experienced by the computer business in recent years the amount of funding available for research in Olivetti has much reduced. Hence the number of research centres has been reduced to only one in Cambridge. The centres in Silicon Valley and even Northern Italy have been redirected to much more development oriented tasks. I take this as a validation not only of our but of the UK strength in research.

In summary Olivetti provides funding with few strings attached and expects world class research in return. The UK science base continues to be at a level which makes this possible.

Exploitation of results is done in a number of ways. Divisions within the Company sometimes decide to exploit a technology. From time-to-time a licence is negotiated with a third party. Most interesting of all (from a UK plc point of view) is where a Company is spun out from the research laboratory. This has happened recently with a development in the communications area. The spin-out has been established on another site in Cambridge and will shortly employ about 25 people. I would expect it over a period of time to attract an investment of approximately 5 million pounds from sources outside the UK.

I consider the above a rosy picture but I would like to bring to your attention some less good aspects of the context in which we make an investment in UK research.

Olivetti Research is set up as a separate UK limited Company. The reason for this is to make it easy to manage in a way not unnecessarily burdened by the procedures of a large company. The Revenue have tried to argue that hence we should be taxed at the full rate on our research budget. This would in effect tax the research as if it was a product and would make a research lab here an unattractive proposition. A lot of time and money has been spent dealing with the Revenue—this is particularly unfortunate as there is an Italy/UK tax treaty which would make tax deductible all research costs if only we were not a limited Company.

Although working in industry I have a Faculty position at the University of Cambridge which gives the underpinning to the work being done at Olivetti. I thus have some insight into funding of University personnel. It is desperately difficult for my colleagues working in similar (and hence wealth creating) areas to receive research funding. This is both because there is not enough money available and also because the peer review process has almost collapsed. By example a proposal was recently put in by an academic research institution with support from Olivetti. The SERC was asked for 220K pounds and Olivetti would have contributed 600K pounds over the life of the project. The proposal was thrown out with little feedback to the proposer and no feedback to us whatsoever. Other companies who have tried to support University groups have also been turned down resulting in a major research area having no University participation at all.

Making an Industry/University research relationship work well requires both formal and informal management. Olivetti management has been very flexible. The emphasis in Universities is now much more on formal assessment. I think it would be disadvantageous if senior University figures were constrained in the arrangements they make by some political requirement. Many successful ventures come about because a risk was taken at some point.

Another area where I see difficulties is the fall out from the political uncertainty about the UK commitment to the European Union. Large corporations make strategic decisions about investment and I have recently observed the trend to invest in research in continental Europe rather than here. In particular the Grenoble area is blossoming and attracting funds which may well have come to the UK.

Examination of witnesses

DR GEOFFREY ROBINSON, Director of the Hursley Park Laboratory, IBM (UK) Laboratories Ltd and DR A HOPPER, Director, Olivetti Research Centre Ltd, were called in and examined.

Chairman

686. Dr Robinson, it is a pleasure to have you with us again, this time in a totally different capacity from your visit last time. We also welcome Dr Hopper. Dr Robinson, I begin by asking you whether you wish to make an opening statement in relation to your present concerns and interests in international investment in United Kingdom science?

(*Dr Robinson*) Perhaps I may make a brief statement about the range of IBM's activities in the United Kingdom to enable you to explore whatever things you believe to be important. We have expenditure of approximately £145 million a year in the United Kingdom on research and development. My own laboratory is primarily concerned with development, which means that it is responsible for producing revenue-earning products on a worldwide basis. Our primary interest lies in product development. As to research where we work with universities, we have links with 20 or 30 universities at various levels. We have major links with Oxford in software engineering research, and we have just made a major donation to Southampton University to explore various aspects of parallel computing. We clearly have many links in employment and training.

687. You told us in February that when you were at the DTI you initiated a policy focus on attracting international investment in United Kingdom science. Now that you have rejoined the investors would you like to comment on how that policy is unfolding and on other government policies which affect the R&D investment decisions of companies like IBM?

(*Dr Robinson*) To deal with the specific question of inward investment policy, you will perhaps recall that we launched a major R&D seminar in Tokyo last autumn. Following the very high level of interest in Japan, before I left the department a mission was organised which resulted in a number of Japanese companies coming to the United Kingdom to look at it as a base for R&D. It was the first time that the department had ever organised an inwards mission on R&D as opposed to the more traditional manufacturing missions that had taken place. I was pleased that I was asked to welcome the Japanese in my new guise. A party of Japanese industrialists visited me at my laboratory and we were able to talk from first-hand experience of our contacts, knowledge and so on in the United Kingdom. The policy appears to be developing. As it happens, yesterday I received a letter from the British Ambassador in Tokyo to say that the mission had gone very well and to thank us for our contribution. As to our own policies for inward investment, to pick up some of the themes that I have just heard, around the world there is a good deal of competition in an industry which invests a lot in R&D but at the same time is increasingly facing cost and profit pressures. We find that we have to compete with other countries in Europe and around the world. The local skill base is clearly an important part of it. I have to say that government policies are not at the forefront of the considerations of companies like IBM. IBM is interested in what the country as a whole has to offer. As long as they are not inhibitors, government policies do not feature very largely in our thinking.

688. Dr Hopper, we have read your paper with interest. Do you wish to make an opening statement?

(*Dr Hopper*) I think it is worth setting the scene. As you know, Olivetti is an Italian company with a head office in that country. It has country-based organisations which primarily are sales-oriented. Olivetti (UK) is one of them and has a turnover of about £200 million. It has development centres in various parts of Italy and also one in Silicon Valley. It has a corporate research centre in Cambridge which activity I look after. I am a research director in the real sense of the word. The funding that we get is corporate funding, not funding that is driven by the market. Therefore, my perspective is very much based on innovation. The kind of work that we do whilst practical is very speculative. It need not be long term. It may be quite short term in delivering results. We have a slight problem about the use of the word "science" because are concerned with engineering technology.

689. You told us that you thought academic researchers in the United Kingdom, particularly in the universities, were being constrained by the process of formal assessment; for example the activities of the higher education funding councils could make them less able to operate flexibly and take risks. Do you have any examples to offer us? Are there any other countries where the public sector researchers are able to be more flexible?

(*Dr Hopper*) You will notice from my statement that though I work for Olivetti I am also a full-time academic with a career at Cambridge. I observe a large number of constraints. Ours are not too bad. I have had experience of trying to innovate and set up new arrangements which frequently involve dealing with a senior person at a university and taking some risk—in effect, putting some money down on the industrial side and being speculative either with some internal funds or with people from the particular

[Chairman *contd.*]

university. One of the side effects of greater measurement and detailed analysis of what the academics are doing is that the person I am dealing with, who is frequently quite senior, at least is busier doing that sort of activity or at worst is more constrained either procedurally or financially.

Lord Perry of Walton

690. You talk about proposals being thrown out when there is no feedback, and also when a lot of industrial money is being offered. We know that the research councils get a lot more applications than they have funds. Do you think that the availability of industrial funds ought to be a factor to be taken into account?

(*Dr Hopper*) Yes, very much so. The particular case that I have in mind relates to telecommunications and information superhighways. We have a pioneering network for universities where to my knowledge no research is being done at the moment. That is a very poor state of affairs. Certainly, if an industrialist comes in with a substantial contribution that ought to have a considerable effect. I think that the procedure has almost collapsed. My irritation arises because there is very little structure to the system given the pressures and the number of applications. One almost feels sometimes that the rejections are the result of a whim. I am sure that that is not so but sometimes that is the impression one has.

Chairman

691. There is another question about the tax treatment of your activities. It almost appears from the response of the Inland Revenue to our anonymised enquiry on your behalf that you could have been wiser to set up your research company here as a branch of the parent company rather than as an independent United Kingdom company. What is your reaction to that?

(*Dr Hopper*) I disagree with the Revenue. To answer your question, I am not satisfied with their reply. Consider the problem of convincing somebody in a head office in Italy to change the majority of the company's procedures as applied there because of the local situation in Cambridge. You are starting the research effort there. You have no track record and what you are doing is speculative. You are asking for a considerable amount of money. The procedures, whether they be to do with salaries, purchasing, contracting and so on, are completely different in the local situation. In a large company it is very difficult to move away from the rule book when considering a branch office. Such a difference may snuff it out. Conversely, if you are a separate limited company, even if you are not trading but are just a direct subsidiary, you can do your own thing. I would not want to underestimate the importance we attach to having that flexibility. At times it has made it clear that we should continue whereas otherwise things may be very grey. Not only has the Revenue failed to treat us as a normal company following all the rules but it has said, "We will take your funding and the full speculative value". That has been done in a context where we have been very speculative. The Revenue says, "Okay. You get £2.5 or £3 million. For tax purposes that is not enough. The value of the service is greater because you are not being speculative. We will call it £3 million, and here is an extra tax". In a context where normally I would expect encouragement and tax breaks from the Revenue, I am being penalised by having to pay extra tax.

Lord Nelson of Stafford

692. As two world trading organisations, I wonder whether you would clarify for us what influenced you in deciding to make your R&D—particularly R—investment in the United Kingdom, whether in your own laboratories or in the universities? Was it the excellence of the facilities or staff, or was it a commercial decision to spread your R&D around because it brought business to you in the particular country?

(*Dr Robinson*) In terms of the very significant expenditure in product development, the factors that would balance our significantly large-scale investments would be: spreading investment around the world in order to be a truly global company; critical mass; and carrying out development in a healthy market so there was a strong feedback from the customer base. In terms of incremental investments in product development, they are very much driven by the skills of the people who are already there and who can be tapped into in that infrastructure. At the research end, in the terms that you would perhaps feel comfortable with, we have 50 people doing speculative research. There is no doubt that links into the United Kingdom university research community help us to win projects to fund on purely a speculative research basis. Those links are very helpful.

Chairman

693. If you had to decide from the beginning where you would locate your R&D facilities would you still come to the United Kingdom? Have you any intention of expanding, contracting or relocating?

(*Dr Robinson*) As far as IBM is concerned, new research investments at the corporate level as of today would quite likely favour the Far East for reasons of skills and market presence. In passing, I should add that as we are a worldwide development laboratory part of our customer base is in China which for us is an extremely active market. It is ironic that with our products we have the joy of helping the Chinese railway system ironic because of the day's train strike. But in terms of the growth and expansion of existing facilities, we have contracted our development facilities in recent years and integrated our development of manufacturing facilities. We do not see any large-scale enhancements in the foreseeable future, but we are doing quite well in holding our own.

(*Dr Hopper*) As far as Olivetti is concerned, it is a computer company and times have been tough. The trend has been downward rather than upward in terms of this kind of investment. However, I think it has levelled out and possibly is beginning to expand. If we were starting from scratch we would very seriously look at other places—even for a research

[Chairman *contd.*]

activity, and most certainly for a development activity—for reasons to do with communications, training people and so on. Having said that, it is very rare that one has a situation of starting from scratch. Practically, Olivetti would like to expand its activity in Cambridge and will probably do so when times are a little better.

Lord Porter of Luddenham

694. I was very interested in the connection with Cambridge. You describe yourself as a full-time academic at Cambridge. Presumably, you are also a full-time research director for Olivetti. You must be operating in relativistic time! This arrangement is rare, and I would like to hear more about it. We have heard about this sort of thing happening in Holland for years and years and we have always rather envied the way the Dutch do it. It is a wonderful way of handling technology transfer and bridging gaps. First, how have you managed to combine those two full-time jobs? Secondly, is the academic job a full one, including teaching and everything else? How closely connected with Olivetti is it?

(*Dr Hopper*) My position in the university is reader in computer technology. I have been in the computer laboratory for 15 or 20 years. I perform completely normal academic duties. It can be looked at in two ways. As an academic there is no chance in hell of my getting the sort of money that I would like to have for the research that I would like to do. In my career I have not as yet ever had a CERC grant or anything like that. It has always been an industrial activity. The reason it has come about is that my college in Cambridge and my head of department have been able to make decisions that are relatively unconstrained and so have been able to take a longer view. I can briefly summarise the history. I was one of the founders of a company called Acorn which developed the BBC machine. That machine did well because it had some chips in it. The reason it had chips in it was that I had a research programme at university concerned with chip design. That was used. In turn, that company contributed to the university machines and equipment. Olivetti recognised that that was a good thing and similarly started a research laboratory and encouraged precisely that sort of arrangement.

695. What that when you went to Olivetti?
(*Dr Hopper*) Yes.

696. Did they buy you with the Acorn company?
(*Dr Hopper*) Yes. They said, "Well, Acorn has financial difficulties but it has an interesting activity. How would you like to do this for Olivetti Corporation rather than Acorn?" The whole thing grew from there. I should add that Olivetti saw the full-time university connection as extremely beneficial. Olivetti's research connection with Cambridge is better known in Italy than it is in this country. It is promoted as being a great success. There is also a company called ARM Ltd which is a CPU-maker in which Olivetti has a substantial investment. That company has become a world leader in this activity. That is seen very much as a success. We have just spun out that company which is currently working on asynchronous transfer modes. There are about 30 people working for that company. To have a situation where a research laboratory can generate a start-up company in respect of which venture capitalists are queuing up to invest money I regard as a success. What is important is that that is seen as being provided by the university. Without being unkind to other places, if we were based in Royston it might not be so successful. That is working very well. Olivetti has maintained funding in very difficult circumstances where much of the research activity worldwide, including centres in the United States, has been soliciting funds.

697. Do you feel there is much more scope for the coupling of academia and industry, especially industry overseas?

(*Dr Hopper*) For certain types of academics, yes. On the one hand, I am very keen to see theoreticians, blue sky or any kind of academics involved in this activity. On the other hand, we are very practically-minded people, particularly in engineering and technology. There are certain tensions which have nothing to do with conflicts of interest—which can be overcome in relatively straightforward ways—but are concerned with such things as academic assessment. Academic assessment is not geared to measuring this kind of activity. If a young researcher were asking me advice I would say, "You might have to consider that you will prejudice some of your publications against other successes, and therefore you may not be judged quite as well as others. You may be but you may not be". In terms of hours and so on, the lecturing load is not particularly severe. In my case, most of my PhD students and a colleague's PhD students work with us on some projects, so there is no difference between the two activities; it is one and the same. That is why it is rather different from the much more commercial activities that Olivetti has elsewhere.

Chairman

698. You have a spin-out company from Olivetti at Cambridge. Has IBM produced similar spin-outs?

(*Dr Robinson*) We have not produced spin-out companies in the way that Dr Hopper references in his note. We have had flows of technology ideas out of companies mainly in software areas but also in display technology areas. The most striking example a few years ago was an electro-chrome plating technology which came out of our research. It made the whole process of electro-plating and chroming much safer and cheaper. We licensed that to a major United Kingdom company. We do not go for setting up companies quite so much, but we have a fair flow of technologies.

699. There are a number of other competitors in this field. We have listed Toshiba and Hitachi, both of which have close research relationships with the Cambridge Cavendish Laboratory. As competitors, you are already trying to interact with centres of excellence in the science base. Do you feel that any such relationship, or similar ones elsewhere, is too close, or is it the sort of thing that you would commend?

(*Dr Robinson*) In recent years we have found no problem whatever in interesting and encouraging

[Chairman *contd.*]

relationships with academics. When I was in DTI I found that many academics were concerned about the assessment process not giving due weight to such work, and the academics with whom we now work have that concern, but it is not deterring them from wanting to do the work. The work that we do is undertaken by the universities partly for funding reasons but more often because there is an interest in the technical challenge.

700. In general, are you satisfied with the present state of the British science base particularly in the universities? What are your views about your experience of overhead charging by universities and intellectual property rights?

(*Dr Robinson*) We have not experienced any difficulties. I have been working with universities for about 12 years. I feel that we have got to the bottom of many of the obvious difficulties to do with intellectual property rights. There are some universities that are easier to work with than others, but by and large there is a much more mature attitude. On the whole, we do not find that there are any problems. We find universities much more responsive than they were years ago. If I give any message in that regard it is that there is a lot of competition round the world from academic groups whose work is truly international. We are all working on ATM and all have high bandwidth communications. Universities everywhere want to work with us. We have partnerships with overseas universities as well. I cannot speak for Dr Hopper, but I suspect that, though he is not in the least worried in his position about the United Kingdom university scene, he realises that it has to compete academically internationally in working with industry.

Lord Nelson of Stafford

701. Does that competition lead to, say, price cutting in the university field through reductions in overheads and so on?

(*Dr Robinson*) To be honest, we have not seen it. Price is not really of the essence. What we are looking for are the best people. It is not necessarily a case of having direct contract work where university A bids so much and university B bids something else. It is a question of deciding who are the best people to work with. Price is not an inhibitor for the sort of leading edge research in which we are interested. I should add that we are also spreading our links with universities in terms of training. We contract all of our training to Southampton University, and we are trying to get more providers from universities on training courses, so in that respect we will be looking at a degree of competition. However, in leading edge research we are just looking for the best people.

702. The corollary is that if you have the best people there is no need to cut back on your overheads?

(*Dr Robinson*) Yes, and part of that is the preparedness of the best people to work with industry.

(*Dr Hopper*) Referring to Toshiba and the others, in the broadest sense I welcome that move. It is an asset. I have better links with Toshiba and Hitachi at Cambridge, for example, than would otherwise be the case. When their senior executives come to look at their lab we encourage them to look at other activities. As to quality of staff, in the field of research I agree that the main consideration is quality. We still produce the top quality people and PhDs. Between us we can recruit enough of them. It is very important that the science base continues to have first-class projects—hence my frustration about the lack of funding of particular projects, which have meant that a number of mainstream areas have not been the subject of any research. Therefore, in four or five years time it will perhaps be less obvious that there is a first-class project being pursued.

Chairman

703. What proportion of your respective research programmes is defence related? Will the reduction in the United Kingdom budget for defence research affect either of you?

(*Dr Hopper*) No.

(*Dr Robinson*) In our case, no. IBM sold off all of its government activities round the world a couple of years ago.

Lord Perry of Walton

704. One takes on board what you said about the need to maintain one's position in a competitive world and the need for investment. Do you have any suggestions about what we may advise the Government to do to increase competitiveness?

(*Dr Robinson*) From my point of view, I would say that perhaps the research council system may do two things, one of which Dr Hopper has already alluded to: to give credit for industrially relevant research. The second matter is that the councils may consider the extent to which they are encouraging research projects in universities that have direct international linkage. I do not mean specifically an international company in the United Kingdom like ours. I am talking of overseas linkage on an industrial base. In that way they will perhaps be more aware of the competition, not just in academic research with which they are very familiar but research relating to industry. Any mechanism that research councils may use to encourage overseas linkages will be helpful in getting that message across.

Lord Porter of Luddenham

705. Do you think that in the science base you have got the balance about right between engineering and applied research as far as the funding is concerned? Is there too much of one and not enough of the other?

(*Dr Robinson*) I do not believe that to be one of our major problems. If I recall, your Lordship and I have had conversations in the past about pure science and engineering. I admit that, for my sins, I am a member of the Particle Physics and Astronomy Research Council just to prove that I can be interested in pure science. Personally, I believe that the boundary between science and engineering is more important to the academic than the industrialist. An industrialist is interested in what is relevant to him, not what it is called. Therefore, the distinction may be a little arbitrary. If we are making the distinction

[Lord Porter of Luddenham *contd.*]

between work which has no conceivable relevance that we can think of and work which appears to be relevant because industry shows an interest in it, then that boundary should be constantly tested.

Earl of Selborne

706. I wonder whether I may revert to Dr Hopper's paper and his last statement, that in particular the Grenoble area is blossoming and is attracting funds that may well have come from the United Kingdom. What should we be doing in this country, or what is Grenoble doing that we are not doing?

(*Dr Hopper*) I gave that as an example of a competitive situation and a trend. I instanced that because I had noticed that several companies who otherwise might have started or expanded in Cambridge had gone there. I found myself going down there and thinking, "Well, we seem to be missing out". I also have experience of negotiating with other companies. For example, you may be interested to know that Olivetti Research was partly funded by Digital Equipment Corporation for a number of years. That was normal funding in the way that corporate funding takes place now. I have discussed this matter with others. When one gets to the level of senior executives inevitably they consider political and general points, as well as all the other ones that are about technology, people and so on. I have come across more than one who has held the view that the United Kingdom and its position as presented by the Government is not in the mainstream of Europe. Therefore, that is one of the considerations that they have in mind. I was very pleased to see the mayor of Grenoble on French television trumpeting some new R&D activity. I suspect that the French Government is rather more encouraging about that than our Government. Of course, they are located in the continental part of Europe, whereas the United Kingdom is perhaps perceived as being more on the periphery.

Chairman

707. Is either of you aware of any locations across the world where, for example, governments provide tax credits to enable companies to start up R&D facilities?

(*Dr Robinson*) There is a scheme in Australia. You may care to ask them about it directly. When I talked to them they wondered whether it was effective but said that it gave the right signal. I am not personally familiar with any others. To make one other point in addition to what Dr Hopper said, it was clear when I was at the DTI and met the Japanese and they visited me at IBM that it was very important to them for the United Kingdom to be seen as part of Europe in an effective way. In addition, being made to feel welcome was very important, and they do feel more welcome in Britain than elsewhere.

Chairman] Thank you, gentlemen. If you have any afterthoughts and feel that any important issues of which you wish us to take note have not been dealt with in discussion today please write to us.

WRITTEN EVIDENCE

GOVERNMENT DEPARTMENTS

Evidence from the Ministry of Agriculture, Fisheries and Food

THE DEPARTMENT'S RESEARCH ESTABLISHMENTS

1. MAFF is either sponsor for or owns the following research establishments:

Central Science Laboratory (CSL)
Central Veterinary Laboratory (CVL)
Eleven research centres in ADAS
Food Science Laboratory — Norwich
Torry Research Station
Fisheries Research Laboratories — Lowestoft, Burnham-on-Crouch, Conwy and Weymouth
Horticulture Research International (HRI)
Royal Botanic Gardens — Kew

Central Science Laboratory

2. CSL became an Executive Agency in April 1992. It is primarily engaged in the provision of R & D and technical advice and support for the Ministry of Agriculture, Fisheries and Food, other government departments and the private sector. Areas covered include plant health, pesticide safety, residues in food, the control of pests and diseases of growing and stored crops, wildlife management and the impact of agriculture on the environment. Over 90% of its work is funded by MAFF. From 1 April 1994 the Food Science Laboratory at Norwich and Torry Research Station will become part of the CSL.

Central Veterinary Laboratory

3. CVL is an Executive Agency of MAFF. It provides the Ministry with a source of specialist scientific and technical expertise in the field of animal and public health and has a high, international reputation in this area.

ADAS

4. ADAS became an Executive Agency on 1 April 1992. It provides a comprehensive range of consultancy services to the land-based industries and in addition carries out research for both MAFF and the private sector, at research centres spread throughout England and Wales. These represent the variety of climatic and soil conditions experienced by farmers in different parts of the country.

Food Science Laboratory — Norwich and the Torry Research Station

5. The Food Science Laboratory at Norwich and the Torry Research Station are currently part of the Food Science Group within MAFF. Both assist the department in the development of policy on food safety by providing technical information and advice. They will become part of an enlarged Central Science Laboratory Agency on 1 April 1994. Both undertake research and development into food safety, the laboratory at Norwich concentrating on the chemical aspects of food safety, whilst Torry works on the safety and quality of food products, including microbiological safety.

Fisheries Research Laboratories

The fisheries laboratories are part of the Fisheries Group in MAFF and undertake research in support of MAFF's fisheries policies.

Horticulture Research International

7. Prior to its launch in October 1990, HRI was known as the British Society for Horticultural Research (BSHR) and was formed from the merger of the Agricultural and Food Research Council's (AFRC) Institute of Horticultural Research and ADAS Experimental Horticulture Stations. BSHR became an executive Non-Departmental Public Body (NDPB) operating on Next Steps lines on 1 April 1990. Its purpose is to carry out research and development work for its customers in support of horticulture and associated industries, including forestry, and to exploit the results commercially. It is sponsored by MAFF who provide 64% of its research income in the form of commissions.

Royal Botanic Gardens — Kew

8. The 1983 National Heritage Act set up the Royal Botanic Gardens Kew, as a corporate body, at which time responsibility for their management was transferred from the Minister of Agriculture, Fisheries and Food to the Board of Trustees. However, Kew has continued to be funded by a grant-in-aid from MAFF and

this represents around 75% of its income. In addition to a range of other activities, RBG Kew is concerned with major research programmes in Plant Anatomy, Biochemistry, Cytology, Physiology, Molecular Systematics, Taxonomy and Conservation.

PROPORTION OF RESEARCH ESTABLISHMENTS' INCOME FROM OVERSEAS

Central Science Laboratory

9. In 1992-1993 CSL received £103,200 from overseas. This represents 0.6% of turnover (the invoiced amount of goods and services provided net of Value Added Tax). £51,000 of this came from the European Community.

Central Veterinary Laboratory

10. Based on results for the first nine months of the 1993-1994 financial year, 2.3% of the income of CVL is provided from overseas. This is considered by the Chief Executive to be representative of the CVL position.

ADAS

11. ADAS's R & D budget currently stands at around £20 million. Of this 0.5% comes from overseas.

Food Science Laboratory — Norwich

12. During 1993-1994 the total R & D income for the laboratory will be £2,155,000 and non-R & D income £2,512,000. Income from overseas will be £51,000, ie some 1% of the total.

Torry Research Station

13. Receipts for contracted work at Torry Research Station from overseas R & D and scientific consultancy services will amount to a total of £150,000 in 1993-1994, representing around 4% of the budget received from MAFF.

14. The sources of income were the European Union, Japan, New Zealand and the Food and Agriculture Organisation of the United Nations.

Fisheries Research Laboratories

15. None of the income of the fisheries laboratories comes from overseas. There is however considerable international collaboration.

Horticulture Research International

16. In 1993–94, HRI's total income is expected to be £23.78 million made up as follows:

MAFF	£13.55 million
AFRC	£3.98 million
Other	£6.25 million

Within the "other" category, overseas income is expected to be £1.43 million, made up of:

CEC	£905,000
ODA/NRI/British Council	£184,000
Other	£341,000

This represents six per cent of the total income.

Royal Botanic Gardens—Kew

17. For the financial year 1993–94 Kew has funding of £206,500 from overseas representing around one per cent of the total income. Of this £78,500 came from the EC, £35,000 from the FAO (UN), £65,000 from the United States and £28,000 from Shell Brunei.

February 1994

Letter from the Department for Education

Thank you for your letter of 4 February enquiring about DFE policies in respect of postgraduate research students from overseas.

Our position on overseas students generally is that it is for individual universities and colleges to determine their policy on admissions and on the level of any fees to be paid. Apart from the special programme outlined below, the Department's allocation of funds for higher education to the Higher Education Funding Council for England makes no provision for non-EC overseas students. It is assumed that—with the exception of those from other EC member states, to whom different rules apply because of our EC Treaty obligations—universities and colleges charge fees at a level which will cover the costs of providing for such students.

It is mainly for others to consider providing grants to overseas students. The Department does however provide limited funds through the HEFCE to assist outstanding postgraduate research students who can be expected to contribute significantly to achievements in research in the UK. These funds are distributed to individual students under the auspices of the Committee of Vice-Chancellors and Principals. Expenditure amounted to some £8.8 million in 1992–93, when 2,081 students received grants. A recent evaluation by the Higher Education Funding Council for England concluded that this scheme was worthy of continuing support given the benefits accruing to UK universities.

Postgraduate students who are nationals of other EC member states are eligible to compete for awards, covering tuition fees up to a specified maximum level, made by the British Academy and under the various DFE postgraduate award schemes. (Similar arrangements apply to Research Council awards.) Under the EC ERASMUS scheme, student mobility programmes may involve students at any level of study up to and including PhD; nationals of other EC member states or EFTA countries may therefore qualify for ERASMUS student mobility grants to undertake postgraduate research in the UK.

With regard to your invitation to comment on the subject of the inquiry, the Department has no specific opinion for the time being.

23 February 1994

Letter from the Department of the Environment

Thank you for your letter of 1 February about international investment in UK science to Mr Bailey; I am replying on behalf of his successor, Mr Bristow.

The Department's sole research establishment is the Building Research Establishment (BRE). Its projected total income for the financial year 1993-94 is £40.91m, of which the following proportion comes from overseas.

Source	*Projected Income (£K)*	*% of Projected Total (ie £40.91m)*
Europe (EC)	513.9	1.3
Europe (Rest)	11.6	0.02
Rest of World	92.3	0.2
Total Overseas	617.8	1.52

I should point out that all figures contain elements of both research and technical consultancy and to separate them convincingly would be difficult and perhaps not fruitful.

Please let me know if you need any further information.

28 February 1994

Evidence from the Foreign and Commonwealth Office

Question 1: Do British Embassies have a particular role in encouraging overseas investment in UK science, whether commercial or by foreign governments?

1. Science and technology sections at our Embassies in Bonn, Paris, Moscow, Rome, Tokyo and Washington have a role in promoting British science overseas, and thereby encouraging investment in British science.

2. The Foreign and Commonwealth Office also have nearly 40 full-time UK-based and locally engaged staff in the USA, Canada, Japan, Germany, Switzerland, Korea and Taiwan, working on inward investment, including, though not predominantly, in science and technology. They made nearly 2,500 calls on potential investors and arranged 138 tours of the UK for them in 1992-93. Many other staff elsewhere, even in markets where the potential is quite small, spend a proportion of their time promoting the UK as the ideal location for foreign companies to invest.

3. A good example of what British Embassies can do was an exercise carried out in February 1993 by British Embassies in those European countries which are members of the European Molecular Biology Laboratory, to lobby host governments on behalf of the bid by Cambridge to host the European Bioinformatics Institute. Cambridge was successful, defeating rival German and Swedish bids. The Institute

will form a central part of the genome campus at Hinxton Park, which is well placed to become a world-class centre for research in genome studies and bioinformatics.

Question 2: Please supply a brief account of the Chevening Scholarship Scheme, and any other FCO schemes which support individual scientists from overseas working in the UK.

THE FCO'S SCHOLARSHIPS PROGRAMME FOR OVERSEAS STUDENTS

Support for overseas scientists

1. The attached note describes the FCO's current programme of scholarships generally for overseas students including the recently re-named "British Chevening Scholarships" programme.

2. The objective of the FCO's scholarship schemes is not primarily to support the studies of overseas scientists in the United Kingdom. But as a result of the application of the various schemes' criteria, a large number of candidates in both pure and applied sciences are receiving FCO scholarship support:—

British Chevening Scholarships

Areas of Study	1992/3	1993/4
Pure Science	204	196
Engineering and Technology	325	325
Biological Sciences	83	86
Agriculture and Food Science	79	70
Medicine	185	188
Arts and Humanities	158	156
Education	67	62
Management and Social Sciences	1,012	1,119
International Relations	113	129
Law	78	107
Diplomacy/Foreign Service	65	77
Economics	258	284
Not known	26	42
Total Scholarships	2,653	2,841

British Chevening Scholarships: Jointly-Funded Schemes

3. Several of our schemes are jointly-funded with British firms and other interests and provide scholarships from which science candidates benefit. Subjects covered include computer science, physics, engineering, pure and applied chemistry, mechanical engineering, mathematics, computation fluid dynamics, mechanical engineering, natural gas engineering, petroleum production and management.

4. The jointly-funded schemes include a specific programme with the Royal Society which provides annually for some 50 Fellowships for scientists from the countries of Central and Eastern Europe (including the FSU). The FCO contribution is some £205,000 a year.

Marshall Scholarships (for US postgraduates)

Areas of Study	1992/3	1993/4
Pure Science	11	15
Engineering and Technology	4	8
Biological Sciences	4	3
Agriculture and Food Science	—	—
Medicine	3	3
Arts and Humanities	28	25
Education	1	—
Management and Social Sciences	13	15
International Relations	7	5
Law	2	2
Diplomacy/Foreign Service	—	1
Economics	3	5
Total Scholarships	76	82

Commonwealth Scholarship and Fellowship Plan (CSFP)

Areas of Study	1992/3	1993/4
Pure Science	68	65
Engineering and Technology	13	10
Biological Sciences	18	18
Agriculture and Food Science	—	1
Medicine	22	15
Arts and Humanities	80	78
Education	5	5
Management and Social Sciences	32	25
International Relations	7	9
Law	23	15
Economics	10	7
Total Scholarships	278	248

5. The CSFP is jointly funded by the Diplomatic and Aid (ODA) Wings of the FCO. The latter funds scholarships for candidates from the developing Commonwealth countries; the Diplomatic Wing funds candidates from Australia, Canada and New Zealand. The above figures cover only the latter part of the programme.

BRITISH CHEVENING SCHOLARSHIPS

1. The Foreign and Commonwealth Offices's "British Chevening Scholarships" programme aims to win influential friends overseas for Britain and benefit our political, diplomatic, commercial and other interests. The Scholarships, on offer in 140 countries, enable future leaders, decision makers and opinion formers from around the world to become familiar at first hand with the UK and the English language. British Chevening Scholarships were formerly known as the Foreign and Commonwealth Office Scholarships and Awards Scheme—FCOSAS—which was established in 1983.

2. The programme currently provides nearly 3,000 scholarships a year (worth some £23 million in 1994–95) for postgraduate studies or research in almost any field at UK institutions of higher education in the public sector. Most scholarships are for one year. Awards may also be given for shorter, vocationally oriented courses, lasting between three and six months. Awards may cover all or part of the costs. Shared funding scholarship arrangements with British firms, universities, trusts, foundations and other appropriate organisations are a significant feature of the programme, currently worth some £7 million a year.

3. Candidates for British Chevening Scholarships are selected by British diplomatic missions overseas with preference being given to postgraduates or those already established in a career. The Scholarships are administered overseas and in the UK by the British Council on behalf of the FCO.

4. Apart from the British Chevening Scholarships the FCO also fund other scholarship programmes for overseas students, notably Marshall Scholarships for United States students and the Commonwealth Scholarship and Fellowship Plan. Altogether the Diplomatic Wing of the FCO sponsors a total of some 6,000 students each year from practically every country in the world at a total cost of £30 million.

Question 3: What is the current distribution of Science Counsellors etc, in British Embassies? What is their role?

1. Science and technology issues are covered by dedicated staff in six Embassies abroad and, with a much more restricted service, by commercial and political sections in other Posts. Current staffing levels are as set out in the following table:

Post	*Counsellor*	*First Secretary*	*Second Secretary*	*Third Secretary*
Bonn	1	1	—	1
Moscow	1(a)	—	1(b)	1(b)
Paris	1	1	1	—
Rome	—	0.35	—	—
Tokyo	1	2	—	—
Washington	1(c)	1	—	—

Notes

(a) Counsellor (Economic/Aid/S&T) from mid-1994, replacing Counsellor (S&T).

(b) Second Secretary from mid-1994, replacing Third Secretary.

(c) Counsellor currently overbearing First Secretary slot.

2. Staff at these posts have specific remits and are tasked by Whitehall departments. In so far as it is possible to define the core activities of the sections, these might be described as follows:

— Establishing regular and efficient direct channels of communication between the UK, the host scientific community, and officials to help preserve the depth and vitality of the UK's S&T relations with the country in question.

— Reporting to London on new policy initiatives and programmes in S&T, the host government's expenditure plans, and overall research priorities, thereby providing the UK Government with a detailed picture of policy trends in leading competitor countries.

— Informing Government Departments of opportunities for scientific collaboration in a wide range of fields. Identification of potential foreign investors in the UK.

— Keeping host authorities abreast of new S&T developments in the UK. Bolstering the mutual exchange of information through programmes of inward and outward visits.

3. The White Paper "Realising our Potential: A Strategy for Science, Engineering and Technology", published in 1993, announced that "the activities and responsibilities of science and technology sections in our overseas Embassies will be reviewed". This review is now being carried out as a joint exercise by the Foreign and Commonwealth Office, the Office of Science and Technology, and the Department of Trade and Industry. The review will examine:

— The promotion of British science and technology abroad by British Embassies as well as by British Council Science Officers.

— The demand from within Whitehall, industry and the science community for the information and services currently provided by S&T sections overseas, and mechanisms for disseminating that information within the UK.

— The extent to which the demand for such work can be met now, and in the future.

4. Management consultants Segal Quince Wicksteed have been appointed to survey and analyse the demand for overseas science and technology work currently provided by Embassies, the extent to which customers feel their needs are met, and any improvements those customers suggest. An announcement of action to be taken resulting from the review will be made later this year.

Question 4: Which Foreign Countries maintain a Science Counsellor in London?

1. The following diplomatic missions have notified to the FCO's Protocol Department that they maintain a Counsellor in London responsible for scientific matters:

Australia (also a Minister)
Canada
China
Finland
France
Germany
Hungary
Israel
Sweden
Ukraine
USA

2. However, other missions have officers at a more junior grade working on science and technology issues. Further, Counsellors responsible for economic and commercial affairs in some missions also take an interest in scientific matters. A more accurate impression of those members of the diplomatic community in London who take an active interest in science and technology is given by the attached list (*not printed*) of diplomatic members of the London Diplomatic Science Club, an informal organisation of science attaches and others interested in scientific issues. The Foreign and Commonwealth Office last year sponsored visits of London-based scientific attaches (all members of this Club) to Scotland and to Cambridge, to visit a range of public and private sector R & D facilities, and discuss possibilities for collaboration.

3. It should be emphasised that the roles of science attaches are very different between different Embassies. The work of some is more akin to that of our British Council science officers, focussing, for example, on scientific exchanges. Others have an almost exclusively commercial orientation, and carry out work which in our Embassies overseas would fall more to commercial than science sections.

Background note from the Department of Health

1. The Committee has recently launched an enquiry into International Investment in UK Science, chaired by Lord Walton of Detchant. It aims to report to the House of Lords in July (deadline for written submissions 29 May).

2. Its remit embraces overseas investment in research in science, engineering or medicine carried on in the UK for civil or defence purposes. The Committee has identified five questions in its call for evidence. These questions are:

a. What is the extent, nature and variety of overseas investment in UK science? How does this compare with investment by UK interests in science overseas?

b. What factors influence potential investors in deciding whether to come to the UK, or to go elsewhere?

c. What are the benefits to the parties concerned, and the wider UK economy?

d. What is the level of expenditure by investors, and are there costs to the hosts?

e. What are the policy implications for the British Government and British science?

3. The Clerk of the Committee has invited the Department to provide some factual background material to assist this exercise. This note identifies the general position of international investment for the pharmaceutical industry, paticularly with regard to the Pharmaceutical Price Regulation Scheme and the wider R & D environment for the industry in the UK.

Pharmaceutical Price Regulation Scheme (PPRS)

4. The Department of Health is responsible for operating the PPRS, the objectives of which are to:

a. secure the provision of safe and effective medicines for the NHS at reasonable prices;

b. promote a strong and profitable pharmaceutical industry in the United Kingdom capable of such sustained research and development expenditure as should lead to the future availability of new and improved medicines; and

c. encourage in the United Kingdom the efficient and competitive development and supply of medicines to pharmaceutical markets in this and other countries.

5. Research and development costs account for approximately twenty per cent of NHS medicine prices, currently about £600 million a year.

6. This estimate of expenditure on research and development includes original research to discover/engineer a new chemical molecule or the equivalent in bioscience—develop the efficient synthesis of the molecule—testing for stability and toxicology—testing in healthy volunteers and then patients—preparing the dossier for market approval (in the UK this is a Product Licence)—monitoring for side effects after marketing—investigating improved delivery mechanisms and new indications. The associated administration costs of R&D personnel, equipment, and buildings, including capital costs such as depreciation are also all included in the one figure.

7. The major pharmaceutical companies submit a financial return to the Department of Health each year covering sales of medicines to the NHS and a number of cost heads including one for research and development. These returns are commercial in confidence and, in any case, do not sub-divide the research and development cost head into the various different categories of expenditure.

8. Approximately one third of the industry supplying the NHS with medicines in the United Kingdom is British based and the other two thirds are affiliates of overseas companies. As might be expected, the British companies carry out far more of their research and development in the UK than do overseas companies. Although it is fair to say that some overseas companies have substantial research and development centres in Britain some only do the minimum necessary to obtain product licences for their medicines.

9. Both British and overseas based companies sometimes pay/sponsor external agencies for parts of their research. For example, they might collaborate with universities and/or teaching hospitals by directly paying for work or by funding posts/equipment/buildings. Also both British and overseas companies may decide to sub-contract out various parts of the research cycle such as toxicology testing to a specialist company. All of these sub-divisions are subsumed in the expenditure figure.

The R&D environment in the UK for the pharmaceutical industry

10. Pharmaceutical companies spend about 15 per cent of their world wide sales on R&D, so the 20 per cent allowed in NHS prices is a generous level of support with its five percentage points premium. To put it another way, UK support for pharmaceutical R&D is one third higher than the industry average rate of spend on R&D.

11. The PPRS allows freedom of pricing for the launch in the UK of new products based on new chemical entities or biological products of comparable innovation. This has 3 major advantages for the research based pharmaceutical companies—

(a) high R&D costs can start to be recouped from day one of the launch of the new product on to the market;

(b) after a product licence (PL) has been obtained, there are nc further government obstacles to be overcome before product launch; and

(c) the freedom to set the UK launch price for a new product is invaluable for companies when negotiating prices for overseas sales.

12. The PPRS rewards capital whether from UK or overseas based companies. As would be expected, UK companies invest in the UK but so do some of the overseas companies—and, in some cases, very substantially. The new renegotiated PPRS will run for a further five years from October 1993 and will continue to provide stability for the industry and the same generous levels of support for R&D.

13. The NHS provides a superb infrastructure for clinical trials, with the added advantage of English being the universal scientific language. Many of the NHS teaching hospitals have world renowned centres of excellence in particular therapeutic areas which allow international pharmaceutical companies to cooperate with the staff working in these areas to carry out basic research and cost effectiveness studies.

14. The NHS has recognised the importance of R&D for all aspects of the NHS. Professor Peckham, Director of R&D, has establish a comprehensive and coherent NHS research strategy. The assessment of health technologies and medical interventions is a key part of this strategy and attracts a limited amount of investment from the USA in trials and evaluations of such interventions.

15. The MCA has reorganised itself on business lines and provides the fastest licensing service for new products (new active substances) in the world. The UK licensing system is universally respected, and a UK product licence already obtained is helpful when applying for a licence in the US and other overseas markets.

16. The MCA is currently the leading rapporteur for taking forward companies' applications for EC central licensing of products and this experience means that the UK has already established a competence in handling such central licensing issues. This is now very much enhanced by the siting of the EMEA in London.

Conclusion

17. The Government's strategy for science and technology, set out in the White Paper "Realising our Potential: A Strategy for Science, Engineering and Technology", published in May 1993, encourages a climate in the UK for more and better targeted R&D for industry generally. The Department of Health highlighted the role of R&D in informing more effective and cost-effective health and medical care in its publication "Research for Health", and in its contribution to the forthcoming "Forward Look of Government Funded Science and Technology", due to be published by the Office of Science and Technology in April 1994.

Evidence from the Department of Health

Background

1. The Government's strategy for science and technology, set out in the White Paper "Realising our Potential: A Strategy for Science, Engineering and Technology", published in May 1993, encourages a climate in the UK for better targeted R&D for industry. The Department of Health highlighted the role of R&D in informing more effective and cost-effective health and medical care in its publication "Research for Health", and in its contribution to the "Forward Look of Government Funded Science and Technology 1994", published by the Office of Science and Technology.

2. This memorandum of evidence provides a brief outline of the position in the health and medical sciences. It identifies UK interests in the pharmaceutical, medical devices and biotechnology fields, and the role played by the NHS as an R&D test bed for domestic and overseas investors.

3. The Department of Health has a specific interest in overseas industrial investment through its management of the Pharmaceutical Price Regulation Scheme (PPRS), the objectives of which are to:

a. secure the provision of safe and effective medicines for the NHS at reasonable prices;

b. promote a strong and profitable pharmaceutical industry in the United Kingdom capable of such sustained research and development expenditure as should lead to the future availability of new and improved medicines; and

c. encourage the efficient and competitive development and supply of medicines to pharmaceutical markets in this and other countries.

Questions

a. What is the extent, nature and variety of overseas investment in UK science? How does this compare with investment by UK interests in science overseas?

4. The UK has a long history of international collaboration in the health related sciences. Traditionally, overseas investment has been attracted by the high profile and reputation of UK science and industry. In the 1990s individual companies are increasingly operating across frontiers. Investment by our traditional scientific partners, in North America and Europe, is being supplemented by new investment from the Far East, especially Japan.

5. In Europe, mechanisms such as the European Union's (EU) Framework research programme and allied initiatives such as COST are encouraging improved networking between scientists in different European countries. Such collaboration in pre-competitive industrial research is also a factor in enabling EU companies

to forge the links within other member states which are needed to exploit the opportunities offered by the single European market.

6. On the pharmaceutical side, around one-third of the industry supplying the NHS with medicines in the United Kingdom is British based and the other two thirds are affiliates of overseas companies. As might be expected, the British companies carry out far more of their research and development in the UK than do overseas companies. Some overseas companies have substantial research and development centres in Britain but some only do the minimum necessary to obtain product licences for their medicines.

7. The four big British pharmaceutical companies, Glaxo, Zeneca, Wellcome and SmithKline Beecham (which is jointly US/UK owned), and even the smaller ones such as Fisons and Boots, all invest overseas for political and strategic reasons. The UK represents only three per cent of the world pharmaceutical market, and for the big British companies even if the UK accounts for 10 per cent of their output, it leaves 90 per cent going to foreign markets. In particular, the US market which is the largest pharmaceutical market in the world and the major market for most of the British companies.

8. The UK is also playing a leading role in the emerging bio-technology industry, through companies such as Celltech (who started out with significant Government support and scientific input from the MRC) and other smaller developing companies such as British Biotechnology Group and Cambridge Antibody Technology. There is also considerable overseas investment in the UK through companies such as Dupont and Biogen (American), and Boehringer (German).

9. In the medical devices industry, the strength of British scientists has lead to significant investment. Examples of companies and their products include: Johnson and Johnson (implants and prostheses), General Electronics Company (GEC) (training aids for minimally invasive surgery), Ciba-Geigy, DAKO (developing immunocytochemistry), Serono (immunoassay biosensors) and Baxter Healthcare (biosensors for blood glucose).

10. Other examples of inward investment include increasing numbers of partnerships between foreign industry and UK academic institutions, this can be seen through developments such as the EISAI Laboratory and the Hammamatsu Chair in Medical Photonics both at University College London.

11. The NHS plays an important part in encouraging investment and industry is expected to pay the full cost to the NHS of the trials it carries out. The NHS provides a unique test-bed for research and development. Professor Peckham is the Director of R&D and has established a comprehensive NHS research strategy. The assessment of health technologies and medical interventions is a key part of this strategy and attracts a limited amount of investment from the USA in trials and evaluations of such interventions.

12. The UK has taken the lead in mobilising international science to the benefit of both the science base and more generally the economy as a whole. For example the NHS R & D Strategy has established a worldwide network of individuals and locally-funded institutions preparing and maintaining systematic reviews of randomised control trials of health care, through the UK Cochrane Centre, at Oxford.

13. The reputation of UK science and industry is also reflected in the high proportion of successful UK applications to the EU's framework research programmes. A larger fourth framework programme is due to start from the beginning of 1995.

B. *What factors influence potential investors in deciding whether to come to the UK, or to go elsewhere?*

14. Overseas investors come to the UK because of the quality of the science base and research work, with the added advantage of English being the universal scientific language. On the health side, the NHS provides a national infrastructure for clinical trials, and the NHS is unique in being able to provide well characterised and studied cohorts of patients. Many of the NHS teaching hospitals have world renowned centres of excellence in particular therapeutic areas which allow international pharmaceutical companies to cooperate with the staff working in these areas to carry out basic research and cost effectiveness studies. International interest in NHS service developments is shown by the recent example of the Swiss company UNI Clinical Laboratories which has successfully tendered for the supply of pathology services to the North Herts NHS Trust.

15. An NHS Research Task Force, chaired by Professor Anthony Cuyler, Pro-Vice Chancellor of York University, was recently commissioned to review the funding and support of R&D in the NHS, with a view to supporting and developing high quality research at a time of change in the service. Ministers are currently considering the Task Force's findings and recommendations.

16. On the pharmaceutical side, the UK offers domestic and overseas companies specific arrangements through the PPRS. This scheme allows companies freedom of pricing for the launch in the UK of innovative new products so that:

(a) they can start to recoup their R&D costs immediately; and

(b) they have a realistic base price in their home market for negotiating prices for exports.

17. It rewards capital investment in the UK, whether by UK or overseas based companies. As would be expected, UK companies invest in the UK but so do many of the overseas companies—and, in some cases,

very substantially. The new renegotiated PPRS will run for a further five years from October 1993 and will continue to provide stability for the industry and the same generous levels of support for R&D.

18. Pharmaceutical companies on average spend about 15 per cent of their world wide sales on R&D, so the 20 per cent allowed in NHS prices is a generous level of support with its 5 percentage points premium. To put it another way, UK support for pharmaceutical R&D is one third higher than the industry average rate of spend on R&D.

19. After a product licence (PL) has been obtained, there are no further Government obstacles to be overcome before the product launch. The Medicines Control Agency (MCA) has reorganised itself on business lines and provides one of the fastest licensing service for new products (new active substances) in the world. The UK licensing system is universally respected, and a UK product licence already obtained is helpful when applying for a licence in the US and other overseas markets.

20. The MCA is currently the leading rapporteur for taking forward companies' applications for EC central licensing of products and this experience means that the UK has already established a competence in handling such central licensing issues. This is now very much enhanced by the siting of the EMEA in London.

C. *What are the benefits to the parties concerned, and the wider UK economy?*

21. The UK benefits from overseas investment on the health and medical side through a broadening of the science base and better training and educational opportunities. Overseas investment provides a supply of posts for British trained scientists and can provide a route back into the UK for British scientists who had been working abroad, particularly in North America.

22. Both British and overseas based companies sponsor external agencies for parts of their research. For example, they might collaborate with universities and/or teaching hospitals by directly paying for work or by funding posts/equipment/buildings. Also both British and overseas companies may decide to sub-contract out various parts of the research cycle, such as toxicology testing to a specialist company which further strengthens the scientific and industrial base.

23. Five of the top twenty world-wide best selling pharmaceuticals (or thirteen of the top fifty) were researched and developed in the UK. This sends a strong signal to the industry that the UK is a good place to carry out R&D. It is estimated that about 8 per cent of world pharmaceutical research and development expenditure is in the UK compared with around 5 per cent of production and 3 per cent of the world market. This is good for jobs, especially for UK science graduates. It encourages companies to register patents here and source exports from the UK. The economy has benefited considerably from the strong, research-based pharmaceutical industry, providing around 80,000 high quality jobs and a positive balance of trade approaching £1.5 billion.

D. *What is the level of expenditure by investors, and are there costs to the hosts?*

24. Total expenditure in pharmaceutical R&D, including both revenue costs and capital investment, was estimated at about £1.3 billion in 1990.

25. Research and development costs allowed within the PPRS, and thus reflected in the price of medicines to the NHS, account for about 20 per cent of total medicine costs, or currently about £600 million a year. In return the UK receives important benefits from pharmaceutical investment to the economy, to the NHS and to patients, through the early introduction of new and better medicines. The UK is typically one of the first markets in the world to have access to new products.

E. *What are the policy implications for the British Government and British science?*

26. The Department of Health policy aims to ensure:

- efficient commercial practice in industry;
- continued investment in science and technology;
- that products are available at an acceptable cost to the taxpayer; and
- that NHS resources are prioritised to where the NHS has greatest need.

27. Overseas companies and the investment they provide are an important part of these arrangements.

Annex

A NOTE ON THE WORKING OF THE PHARMACEUTICAL PRICE REGULATION SCHEME (PPRS)

1. Under the PPRS, the major pharmaceutical companies submit a financial return to the Department of Health each year providing information on sales of medicines to the NHS and associated costs including an estimate for research and development. These returns are commercial in confidence and do not sub-divide the research and development cost per head into the various different categories of expenditure.

2. This estimate of expenditure on research and development includes original research to discover/engineer a new chemical molecule or the equivalent in bioscience—developing the efficient synthesis of the molecule—testing for stability and toxicology—testing in healthy volunteers and then patients—preparing the dossier for market approval (in the UK this is a Product Licence)—monitoring for side effects after marketing—investigating improved delivery mechanisms and new indications.

3. The associated administration costs of R&D personnel, equipment, and buildings, including capital costs such as depreciation are also all included in the one figure.

Further note from the Department of Health

EUROPEAN MEDICINES EVALUATION AGENCY

At the European Council meeting on 29th October 1993 it was agreed that the European Medicines Evaluation Agency (EMEA) would be established in London. The Agency's Management Board decided on 23 June that it would be located at 7 Westferry Circus, Canary Wharf.

Future systems

The EC's Future Systems legislation for pan-European medicines licensing is due to come into effect on 1 January 1995. It envisages a centralised procedure for licensing certain innovative categories of products and a decentralised procedure for all others.

Under the centralised procedure decisions on licensing will be made by the Committee for Proprietary Medicinal Products (CPMP) or the Committee for Veterinary Medicinal Products (CVMP), as appropriate. A licence issued by decision of either of these Committees, which are incorporated into the EMEA, will be valid throughout the European Union.

Under the decentralised procedure licence applications are made to a national licensing authority. If a licence is issued it will normally be recognised in other member states, but if another member state takes issue with the licensing decision the CPMP/CVMP will consider the matter and reach a binding decision.

EMEA's role

The EMEA is being established to support Future Systems. The EMEA will provide technical and administrative support for the new procedures, including post-marketing surveillance.

EMEA staffing

It is estimated, on the basis of projected workload for both the centralised and decentralised procedures, that the EMEA will have a total of around 250 staff by 1999, of whom around 140 will be technical and scientific personnel.

Evidence from the Inland Revenue

First Extract (Report of Commons Employment Committee)

"65. The CBI identified a particular problem relating to tax:

"If they (business) cannot get the taxation relief because they have not got enough United Kingdom profit to cover the Advanced Corporation Tax payable when their dividend goes out, they will tend to put more of their cost overseas and therefore there is a temptation to take research and development centres and put them overseas to put the cost there so they will have more profit in the United Kingdom, which will cover the dividend."

We understand that measures to deal with this issue have been the subject of consultation with a view to legislative changes being included in the 1994 Finance Act."

1.1 The issue identified by the CBI is one aspect of the so-called "surplus ACT problem". As the Commons Employment Committee observe, measures to deal with that issue were included in the 1994 Finance Act (section 138 and Schedule 16).

1.2 Advance Corporation Tax (ACT) is payable where a UK resident company pays a dividend or makes some other qualifying distribution. Where the company has sufficient profits liable to UK tax, it can use the whole of the ACT paid to off-set the mainstream Corporation Tax which would otherwise be paid on those profits. But where the company has insufficient UK profits, it may have to carry any surplus ACT forward to be relieved against future profits. In some cases, the company may never generate sufficient UK profits to obtain relief for the ACT.

1.3 A company with a substantial proportion of foreign income which has suffered foreign tax may find itself unable to set all its ACT against its mainstream Corporation Tax liability. This can happen where the Corporation Tax liability on the foreign income is covered by double taxation relief, leaving insufficient tax on UK profits to absorb all of the ACT on the distribution of the company's profits (since the distribution may be made both out of foreign income, not taxed in the UK, and UK income). A company in that situation has an incentive to reduce its foreign income and increase its UK source profits and, hence, increase the

Corporation Tax against which any ACT can be set. One way of doing this is, as the CBI say, to locate research and development outside the UK.

1.4 The Government recognises the problem of surplus ACT and the distortions it can cause to companies' international investment and management decisions. The Government's response has been two-fold. In his Budget of March 1993, Norman Lamont announced a reduction in the rate of ACT, over a two-year period, from 25 per cent to 20 per cent. This change reduces the ACT payable, and makes it less likely that a company will have a surplus which cannot be relieved.

1.5 Second, following that Budget a consultative document was issued in respect of a proposed new foreign income dividend scheme to specifically address the problem of surplus ACT which arose because of foreign profits. Following consultation, that scheme has now been enacted in the 1994 Finance Act. The scheme allows a company to identify a dividend paid out of its foreign source profits as a foreign income dividend. The company is then able to claim repayment from the Exchequer of any surplus ACT that arises in respect of that dividend.

1.6 These two measures have done much to alleviate the problem of surplus ACT and the distortions that it can cause.

Second Extract (Anonymised Letter to Committee)

2.1 The anonymised extract apparently relates to a particular case but does not provide sufficient information for the Revenue to identify the point at issue. In particular, we can only make an informed guess at what has been argued by the Revenue and at the reasoning behind the claim from the writer that there is a UK tax treaty which would make tax deductible all research costs if "Research" were not a limited company.

2.2 The extract states that "Research" has been set up as a separate UK limited company. We do not understand what is meant by "the Revenue have tried to argue that hence we should be taxed at the full rate on our research budget". But the following statement, that the research would in effect be taxed as if it were a product, is broadly correct. If a research activity is carried out in a separate company, then the trade of that company is research and it is taxed on the profits of that trade. This is an inevitable consequence of setting up a research establishment as a separate company and, if some of the tax consequences are unwelcome, there may be nothing which can be done to alleviate the result. The tax consequences are, of course, one of the factors that would be taken into account in deciding whether to use a separate company or to set up a research establishment as a UK branch of a foreign multi-national.

2.3 We can only guess at what is meant by the final assertion that the research costs would be tax deductible under a tax treaty with the UK if "Research" were not a limited company. As far as we know, this is not a reference to any specific provision in a UK tax treaty. Our best guess is that it is a reference to the general exclusion which appears in most double taxation treaties for activities carried on in the UK by a person resident in the other treaty partner which are of a preparatory or auxiliary character to the business carried on by that person. Whether that provision would apply would depend on the facts of the case. For example, if the research were carried on solely for a company resident in a country with which the UK has a double taxation treaty and the research establishment had been set up as a branch of that overseas company rather than as a separate limited company, that exemption might well apply. One the other hand, if the research went beyond activities of a preparatory or auxiliary character in relation to the business of that company, or benefited other companies in the group, then the exemption would not run and UK tax would be payable on the profits attributable to the research establishment.

2.4 To summarise briefly, if we have interpreted the extract correctly, the point is as follows. A foreign multi-national has presumably set up a research establishment in the UK as a separate UK limited company. The company is therefore resident in the UK and carrying on research as its trade. It is rightly taxed on any profits therefrom. If the foreign company had chosen to carry on research through a branch in the UK, rather than a separate UK limited company, and the research had been solely of a preparatory or auxiliary character to the business of the foreign company, and did not for instance benefit other members of the group, there would have been no UK tax liability. The tax consequences follow the legal arrangements adopted by the foreign multi-national: if it sets up the activity as a separate legal entity it must be taxed as a separate person—under the internationally accepted principles for the elimination of double taxation, as set out in the OECD Model Tax Convention.

Evidence from the Office of Science and Technology

GUIDANCE ON PARTICIPATION OF FOREIGN OWNED COMPANIES UNDER LINK

This note sets out LINK policy and guidelines for participation of foreign and multi-national companies in LINK programmes. LINK is a UK scheme, which aims to accelerate the commercial exploitation by UK industry of scientific and technology developments in the science base.

Categories of Companies

Companies will fall into one of the following categories:

— UK owned (including multinational);

— EC owned (including multinational);
— Foreign owned with a UK/EC manufacturing base;
— Foreign owned with no UK/EC manufacturing base;

Criteria for eligibility to participate and receive grant aid

— All UK owned companies are eligible to participate in LINK programmes and receive grant aid;
— EC owned companies are eligible to participate and receive grant aid at the discretion of the approving authorities;
— Foreign owned companies with a UK/EC manufacturing base are eligible to participate and receive grant aid at the discretion of the approving authorities;
— Foreign owned companies with no UK/EC manufacturing base are normally not eligible to participate, and are not eligible for grant aid.

It is of course expected that all EC and foreign owned companies that wish to participate in LINK projects will have an adequate R&D resource/facility in the UK, as all research must be carried out in the UK. If no such R&D resource exists, the likelihood is that the information from the project will be fed back to the parent country, with the ensuing possibility that any data not identified and protected (by patent, copyright etc) will be exploited outside the UK. The LINK Secretariat can provide advice if needed.

In the two categories where discretion is needed, the key question that needs to be answered is whether there is a clear and significant net balance of advantage for the UK. In the majority of cases this will mean that the decision on allowing a company to participate in LINK (and possibly to receive grant aid) will depend on whether the research results will lead to commercial exploitation at a UK (or other EC) manufacturing site.

The issue may be complicated by multinational and foreign owned companies admitting that some manufacture may take place outside the EC. Again the key question is whether there will be net benefit to the UK. In such case the argument in support of participation (and possibly grant aid) must be clear and unambiguous. A different complication may arise in cases where a foreign owned company has only a research facility in the UK, but whose participation is regarded as crucial to the success of the project and overall programme. In these circumstances participation may exceptionally be allowed at the discretion of the approving authorities. As above, the LINK Secretariat is ready to provide advice in specific cases where problems of interpretation are met.

8 January 1991

Supplementary evidence from the Department of Trade and Industry

1. *Are there aspects of DTI Policy on Inward Investment which encourage or demand an element of "Local R&D Content"?*

DTI policy on inward investment places no conditions or demands on inward investors, whether in connection with R&D or any other aspect of establishing a facility in the UK. Decisions on the type of investment are left to the commercial judgement of the investor.

Access to Government financial incentives, such as Regional Selective Assistance, is directly dependent on establishing an enterprise in an assisted area and creating jobs. Normally, such enterprises tend to be manufacturing operations. An R&D facility creating jobs would also qualify, but only if in an assisted area.

It is Government policy to encourage inward investment in research, design and development in the UK, especially where such research is linked in the long-term to manufacturing in the UK—or indeed elsewhere in Europe. The Invest in Britain Bureau's overseas seminars promoting inward investment make this point very clearly.

2. *From his experience in Tokyo, what can Dr Hinder tell us about the Japanese end of all this? Does the Japanese Government actively promote or facilitate involvement in science overseas? Where do Japanese firms go for science if they do not come to Britain, and why? Does Japan actively discourage overseas investment in Japanese science? Are there people in Japan to whom we ought to be talking?*

Does the Japanese Government actively promote or facilitate involvement in science overseas?

Ever since the Meiji restoration last century, there has been a predisposition of Japanese generally to look for inspiration and experience overseas. In the post-war reconstruction period of the 1950s, many young Japanese graduates went to the United States for tertiary education and research experience, returning often with MScs or PhDs.

The accent on involvement in US science still continues, though Japanese researchers are beginning to interact more strongly with researchers in European countries these days. Much of this collaboration is sponsored by Japanese families, companies and through fellowships, for example through the Japanese

Society for the Promotion of Science, following the same mechanisms as the UK's own Royal Society. Dr Hinder does not believe that the activities of the Japanese Government in this respect are any more or less intense than the UK's own.

Where do Japanese firms go for science if they don't come to Britain, and why?

Japanese firms generally look first to the United States, for historic reasons. Much depends on personal links established over the years. There are good examples of Japanese researchers who came to Britain, under the auspices of the British Council, who have risen in the ranks of their companies. They are inclined to look to Britain as the base for their R&D centre in Europe. The larger firms are setting up an international network of overseas R&D laboratories: perhaps two or three in the United States, one or two in Europe, and one or two in the Far East outside Japan. Within Europe, Germany, France and the United Kingdom are rated highly.

Does Japan actively discourage overseas investment in Japanese science?

No, they do not. There are increasing links between foreign companies and Japanese scientists. For example, ICI received a warm reception when setting up their research laboratories at Tsukuba, as did Glaxo. Both companies received considerable help from the Japanese.

Are there people in Japan to whom we ought to be talking?

There are potentially many people who would have interesting views in this area. If the Committee wish to talk with overseas companies directly, it might consider talking to some American, French and German companies, alongside Japanese companies. Dr Hinder should be able to supply contacts in Japan. The Committee could also talk to one or two Presidents of Japanese Universities, the Ministry of Education, Science and Culture and other government departments.

22 March 1994

Letter from the Department of Transport

Thank you for your letter of 1 February to Mr Schofield. I am sorry to have just missed your deadline.

This department's only research establishment is the Transport Research Laboratory (TRL) executive agency.

TRL received £320,000 for research projects from the European Communities in 1993 and estimate receipts of £200,000 per annum for this and the two following years. TRL has and will continue to be involved in projects sponsored by the World Bank and Asian Development Bank as well as other international projects. The income involved varies considerably from year to year from very small amounts up to around £250,000.

The total income for TRL is forecast to be £34 million in financial year 1993-94 and £30 million the year after.

Please let me know should you require any further information.

3 March 1994

Evidence from the Welsh Office

1. The Welsh Office actively promotes inward investment to Wales. Much of the implementation of this policy is undertaken by Welsh Development International, the inward investment division of the Welsh Development Agency. Inward investment would normally be defined as capital investment in Wales, by companies based outside Wales, in industrial facilities (in the manufacturing or service sectors) which creates or safeguards employment. Certain aspects of the subject of the Sub-Committee's enquiry would fall within this definition (such as research units set up by overseas owned companies) but it is probably true to say that most overseas interest in research in Wales takes place in other ways.

2. The broad division of responsibility for inward investment promotion between the Welsh Office and Welsh Development International is that Welsh Office sets the broad policy framework which is implemented by Welsh Development International. Nevertheless, Welsh Office often has an active role in individual cases, for example through the provision of Regional Selective Assistance and the direct involvement of Ministers in meeting potential investors. Close liaison is maintained between Welsh Office and Welsh Development International.

3. Inward investment involving science, research and development is particularly encouraged because of the quality of the employment it provides and because of its potential for future growth. Such investment is often undertaken by companies following an initial investment in productive facilities. Consequently, it is important to maintain close contact with companies and to encourage the development of networks involving companies in Wales (both overseas and locally owned) and colleges. The Welsh Office recognises the importance that major companies attach to being close to universities and colleges of international standing in the research field. For this reason, the Higher Education Funding Council in Wales has been charged with

the responsibility of working with institutions in Wales to raise the quality of research. Additional resources have been made available to the Council to help meet this objective.

4. The Welsh Office, in close collaboration with DTI, the Welsh Development Agency, colleges and other organisations in Wales, supports innovation through a range of schemes and initiatives. This includes grants for collaborative research and technology transfer, together with best practice awareness programmes and other measures. In addition to strengthening Welsh industry through specific projects these measures aim to stimulate a favourable climate for research and innovation. Examples include the development and promotion of the science, engineering and technology base, and the setting up of interactive groups such as the Welsh Medical Technology Forum. This work complements the inward investment programme and seeks to take full advantage of the benefits of international collaboration. Of particular note are the close partnerships with Baden-Württemberg and other regions of Europe which include technology transfer initiatives and company collaboration. The Welsh Development Agency, through its Eurolink programme, are key partners in this work, and various EC research programmes help to facilitate collaboration between the universities and colleges in Wales and companies and colleges in other member states.

5. Welsh Development International, supported by the Welsh Office, also maintains close contact with selected universities overseas, because of the important role they can have in encouraging innovative companies to invest in Wales.

6. Overseas involvement in science in Wales remains relatively limited, but interest would appear to be growing. Wales has established a strong record in attracting inward investment, especially in the manufacturing sector, and there is evidence that increasing numbers of these companies are developing research and development capabilities as part of these investments. Particular sectors include consumer electronics, medical devices and automotive components.

RESEARCH COUNCILS

Supplementary evidence from the Biotechnology and Biological Sciences Research Council

Please find enclosed the supplementary information that we agreed to provide to the Select Committee following the oral evidence given by BBSRC on 27 April.

1. Comparison of the number of UK and overseas personnel within the John Innes Centre. The table has been drawn up for the financial year 1993–94 and shows that of a total of 588 personnel, almost 50 per cent were from other European or overseas countries.
2. Expanded information on institute contract earnings from overseas since 1991.

I trust that the information will be helpful to the Select Committee in its deliberations.

JOHN INNES CENTRE (Formerly Institute of Plant Science Research)

1 April 1993 to 31 March 1994

	UK	*Other European*	*Elsewhere*
*Complemented staff	212	4	—
**Funded posts	59	26	19
Visiting Workers	13	74	72
Postgraduate Students	19	22	68
Totals	303	126	159
Grand Total	588		

*Posts funded by BBSRC grant
**Posts funded from other sources

Question 6: The table attached to your memorandum shows contract earnings from overseas interests (not including EC) by your institutes of £4.7 million since 1991. Please tell us more about this.

1. *What sorts of projects are involved?*

The 86 projects, which have a total value of £4.7 million, vary from fairly substantial three year projects worth between £300,000 and £500,000 down to short term projects of three months costing a few thousand pounds, and consultancies for even shorter periods. The average value is about £60,000.

Examples of the larger scale projects include funding for R&D on:

- GABA receptors at the Babraham Institute—funded by DuPont (three years)
- Mechanisms of carnitine action with emphasis on the nature of controls of cell-cell interaction at Babraham Institute—funded by Sigma Tau (five years)
- Potential uses of piperonyl butoxide for controlling Homopteran pests at the Institute of Arable Crops Research—funded by Endura Spa (two years)
- Immunological reagents at the Institute of Animal Health—funded by Rhone Merieux (three years)
- A confidential project at the Institute of Food Research—funded by Kraft (three years)
- Development of triticale varieties at the Institute of Grassland and Environmental Research—funded by Semundo GmbH (three years)
- Evaluation of dietary enzymes feed additives for turkeys at the Roslin Institute—funded by Finn Feeds (three years)

For reasons of commercial confidentiality the exact amounts being invested by the companies cannot be disclosed but each project exceeds £100k in total cost.

2. *What overseas countries are your main customers?*

The overseas countries which are our major customers are, in order, the United States of America, France, other western European countries followed by Japan.

These funding sources reflect the relative strengths of sectors within those countries and in turn those of the UK. For instance, the USA is strong in the emerging biotechnology industries and they recognise the comparative strength of the UK's research base in this field.

Therefore most of the funding from USA falls into this area. Other countries such as France tend to fund into the more traditional areas of say, agrochemicals. A good example of this is the long-term relationship a number of our Institutes have with Rhone Poulenc, a relationship that is much helped by the strong manufacturing base the company now has in the UK coupled with an impressive record for funding R&D both in house and within AFRC.

3. *Why does the work come to UK scientists and to you?*

The primary factor in attracting overseas investment into the UK science base is the high quality of our scientific research and its relevance to the industries concerned. The AFRC has always attached high priority to ensure that the research carried out within institutes satisfies the needs of its user communities. This is coupled with a good track record for the successful delivery of research results.

In addition to providing high quality research with industrial relevance it must also be remembered that the UK costs in terms of scientific salaries are much lower than say the USA or other Western European countries. This does make UK research very good value for money.

4. *What proportion does this represent of the income of the institutes concerned and of AFRC/BBSRC as a whole?*

The figure of £4.7 million over three years represents approximately 1.5 per cent of institute income and less than 1 per cent of AFRC/BBSRC income.

11 May 1994

Evidence from the Medical Research Council

Pursuit of science and technology is increasingly conducted along international lines. More and more collaboration between academic groups crosses national boundaries and international co-operation is very actively encouraged by the EU. Likewise, industrial R&D is founded more and more on a global basis. The concept that "science does not recognise international borders" applies to the academic science base, industrial R&D and relationships between academia and industry.

Our response is in general focused on the experience of MRC research establishments but also takes into account our knowledge (necessarily incomplete) of overseas support for research in universities and other UK sectors.

Q1. *What is the nature and variety of overseas investment in UK science? How does this compare with investment by UK interests in science overseas?*

The MRC receives funds from overseas as a result of awards won through international programmes and through investment by overseas agencies. MRC funding of science overseas is through international subscriptions (many of which the MRC pays on behalf of the UK), contributions to international programmes, and through funding of research overseas, by means of MRC Units and teams, grants and training awards.

The extent of these investments in financial year 1992–93 was as follows:

Overseas funding received by MRC

International Organisations:	European Commission	£1.3m
	World Health Organisation	£0.9m
	Other (Human Frontier Science Programme, International Agency for Research on Cancer, NATO)	£0.4m
		£2.6m
Overseas Agencies:	Government and Public	£0.7m
	Charities	£0.6m
	Industry	£3.5m
		£4.8m
		£7.4m

International subscriptions and overseas research costs met by MRC

International Subscriptions:	European Molecular Biology Conference	£0.7m
	European Molecular Biology Laboratory	£3.3m
	IARC	£0.6m
		£4.6m
Special Contributions (Overseas/International):	HFSPO	£0.4m
	European Science Foundation	£0.3m
	European Collection of Animal Cell Cultures (at Porton Down)	£0.2m
	Genome Database (John Hopkins University)	£0.1m
		£1.0m

MRC Funded Research Overseas:	MRC Laboratories, Gambia	£3.5m
	MRC Laboratories, Jamaica	£0.4m
	Dunn Nutrition Unit, Gambia	£0.6m
	Dr Mulder (MRC Programme on AIDS), Uganda	£1.0m
	Other MRC staff	£0.1m
	Grants	£0.3m
	Training Awards	£0.7m
		£6.6m
		£12.2m

Q2. *What factors influence potential investors in deciding whether to come to the UK for science, or to go elsewhere? (Whether elsewhere in the EC or elsewhere in the world)*

With regard to overseas public sector investment (including international organisations, and non-commercial grant-awarding programmes) the essential criterion will be scientific merit.

We believe the main factors influencing overseas industry support will be—

- Scientific quality and reputation
- Cost
- Professional ability of the host institution in project management and technology transfer
- Flexibility of intellectual property terms offered and negotiated by host institutions
- Geographical proximity and absence of "cultural" barriers.

The biotechnology and pharmaceutical industries have most interest in MRC research and are highly international in their perspective and operations; the last of the factors noted above will therefore have relatively little influence. While it is difficult to generalise, we consider that broadly a good scientific track record and professionalism are as important—probably far more important—than "cheap" access to intellectual property.

Q3. *What are the benefits to the parties concerned, and the wider UK economy? (both short- and long-term, both tangible and intangible—including such matters as training, employment, intellectual property, access to and exploration of results, one form of investment attracting another)*

For commercial funding organisations investing in the UK, the benefits are likely to be:

(a) Training of staff in new techniques

(b) Acquisition of new knowledge and intellectual property

(c) Establishment of a research base within EC, as a possible prelude to the establishment of a UK subsidiary involved in development, manufacturing, marketing operations

(d) Access to equipment, materials, scientific expertise and know-how not readily available at the company's home-base.

The benefits to the host institution are normally:

(a) Expansion of research activities. In some cases the overseas support might be the only source of funding for principal investigators

(b) Provision of additional funds, in those cases where a profit element is included in the costs of contracts

(c) Access to proprietary or expensive research materials or the provision of equipment.

Q4. *What is the level of expenditure by investors, and are there costs (direct, indirect or intangible) to the host?*

The level of expenditure by investors is variable, ranging from the provision of some research reagents to full funding of a research team for extensive periods.

There may be hidden costs to the host institution, either in terms of the payment of overheads at a rate less than required to meet the full economic cost of the research, or of the transmission of intellectual property (prospective or actual) to the investor for little or no consideration. Most universities will be aware of the pitfalls but may not always be in a strong position to negotiate on favourable terms (through lack of the resources and/or alternative sources of support). The research team which allows its core research and intellectual property to pass under the control of one company may, in the long run, deny itself opportunities for support from other companies. However it should be noted that the same risks apply whether the industrial partner is overseas or UK based.

Q5. *What are the policy implications for the British government and British science?*

Restrictions on overseas funding within the UK science base are likely to prove impractical and, more crucially, counterproductive. In the biotechnology or pharmaceutical fields (and no doubt in other high tech, multinational-based industries) it makes no sense for the UK to attempt to ensure that all stages of

development, from basic discovery to finished product, are conducted within the UK or indeed the European Union.

In general, UK academic inventors, universities and research funding bodies (including charities) would prefer to see the UK national economy benefit from UK scientific advances, not merely from royalties but by participation of UK industry in exploitation. The emphasis of government policy should be on encouraging investment by UK industry—either by established UK companies or in the form of UK start-up companies. Measures to assist start-up biotechnology companies in the UK have been introduced recently, particularly by the relaxation of the Stock Exchange criteria for allowing listing of biotechnology companies prior to launch of profit making products. However there is scope for much more activity, given the productivity of the UK science base. Greater awareness and familiarity of the mechanisms and problems in raising and dealing with venture capital in high-tech fields could be stimulated at relatively small expense.

May 1994

Letter from the Natural Environment Research Council

When I appeared before the Select Committee I undertook to provide additional written information in relation to a number of points raised on that occasion. This is given below.

1. *Income from overseas sources*

Dr Buttle's letter of 3 March described the sources of income for the overseas research conducted in four of our institutes (Institute of Hydrology, British Geological Survey, Institute of Terrestrial Ecology (North) and the Institute of Oceanographic Sciences Deacon Laboratory). I attach a similar breakdown for our remaining institutes for 1993–94 (Appendix 1), although you will appreciate that in comparison to the first four, the amount of overseas commissioned research (CR) undertaken by them is smaller.

Data for all our institutes has been summarised in Table 1 (Appendix 2), which shows the total receipts NERC received during the financial year 1993—94 (April 1993–March 1994), in terms of total commissioned research, commissioned research from various overseas sources, and the contribution in terms of percentages the overseas income makes to the overall NERC commissioned research budget. This table clearly highlights the importance of European Commission and ODA funding to NERC.

2. *Inward Investment*

Excluding EC and ODA-funded projects, it is estimated that the percentage of the Council's total income derived from overseas contracts is almost 2 per cent. The contribution to individual institute budgets is shown in the final column of Table 1. This covers the income received from overseas governments, development banks and private sector sources for 1993–94, all of which represent direct inward investment in UK science. Examples of the kinds of projects involved are given below, including the total value of project. (Monies received for these projects in 1993–94 are included in the figures listed in Table 1; the balance will be collected in subsequent years.)

BGS

Socieded Espanola de Estudios	Drilling in the Straits of Gibralter	95k

IH

Lesotho Highland Development Authority	Water supply between Lesotho and South Africa for HEP	150k
Binnie Consultants Ltd (for Hong Kong Government)	Flood Control Strategy (1991–93)	153k

ITE(S)

National Avian Research Centre (NARC) in Abu Dhabi, UEA	Demography of saker falcons in Saudi Arabia and Kazakhstan	73k

IFE

Basque Regional Government	Macroinvertebrates as indicators of river quality	15k
US Army (Corps of Engineers)	Gravel-bed rivers and bed-load movement	17k
German Institute of Hydrology	Dune formation in the River Rhine	30k
Alexander Gibb	Reservoir design in Jordan	

BAS

Falkland Islands Government Fisheries Dept	Biology of two commercially exploited species of squid	27k
World Wildlife Fund for Nature (1994–95)	Development of a GIS for the Southern Ocean, in particular the distribution of Antartic Krill	15k

3. *NERC-supported students and research workers from overseas*

The Missions of all the Research Councils expressly state their role in post-graduate training, and in 1992 the Research Councils collectively funded 52 per cent of students studying for doctorates in the UK. Approximately 8 per cent of this figure was supported by NERC.

NERC support for research and training in HEIs, including access to research vessels and other scientific services and facilities, represents approximately 55 per cent of its Science Budget income (c. £75 million for 1993–94). About half this figure is committed for responsive mode awards for research grants, studentships for advanced courses (largely leading to an MSc), PhD research training, and NERC postdoctoral fellows, almost entirely for UK students in HEIs. Approximately £25 million is devoted to research training (PhD and MSc studentships).

Total NERC-supported students in the UK (1993–94):

Advanced courses (MScs)	220
PhDs	988
CASE awards	203
Post-docs (Fellowships)	66

Of these, the following new awards were made in 1993–94:

Advanced courses (MScs)	220	(c. £1.09 million)
PhDs	310	(c. £6.07 million)
CASE awards	61	(c. £1.46 million)
Post-docs (Fellowships)	19	(c. £1.29 million)

NERC rarely awards money to foreign students for study in the UK. It currently supports eight fees-only PhD studentships (EU nationals) at British universities. Currently, we have no fellowships on a fees-only basis.

NERC employs within its institutes a total of 65 overseas scientists. Of these, there are currently 42 HSOs (post-doctorate level) on 3-year Fixed Term Appointments. The remainder are at more senior grades usually on a permanent basis.

Overseas students or research fellows visiting for over two months during 1993–94 are listed below on an institute basis. Obviously these numbers vary year by year and the list is not definitive, but I trust it gives you a feel for the level of incoming overseas research students and fellows.

BGS

Visiting Research Fellows	2	Spain, Poland

ITE(S)

Visiting Research Fellows	5	Lithuania, India, China, Belgium, Holland
Post-graduate students	2	Italy, Germany
Sabbatical (professors)	1	Australia

ITE(N)

Visiting Research Fellows	2	Poland, Spain
Post-graduate students	11	Costa Rica, Brazil, Cameroon, Belgium, Italy, Austria, Germany, Ghana

IFE

Visiting Research Fellows	4	India, Norway, Spain
Post-graduate students	2	Spain, Estonia
Sabbatical (professors)	2	Australia, Canada

IVEM

Visiting Research Fellows	11	India, Russia, Italy, Canada, China, Japan, Korea, Spain
Post-graduate students	9	China, Russia, Australia, Brazil, Syria

IH

Visiting Research Fellows	5	Brazil (visitors under ABRACOS project), Czech Republic
Post-graduate students	1	Netherlands

DML

Visiting Research Fellows	1	Italy
Post-graduate students	4	Korea, France, Italy, Portugal
Sabbatical (professors)	2	Canada, China

SMRU

Visiting Research Fellows	1	America

IOSDL

Visiting Research Fellows	3	Italy, Canada, Australia
Post-graduate students	2	India, Germany

BAS (HQ)

Visiting Research Fellows	3	New Zealand, Czech Republic, France
Post-graduate students	1	France

PML

Visiting Research Fellows	18	Spain, France, Ukraine, USA, Brazil, Italy, Bulgaria, Singapore,
Post-graduate students	15	France, Germany, Portugal, Korea, Sweden, Netherlands

In addition, all institutes host a wide range of overseas visitors for day visits, either through personal contacts or due to requests from bodies such as the British Council or the Royal Society.

I hope this information fully covers the queries raised. If you need further clarification, please do not hesitate to contact me.

APPENDIX 1

Further examples of the balance of research funded from overseas in NERC institutes.

1993–94 (£000)

Institute of Terrestrial Ecology (South) (ITE(S))

a. ODA	41
b. EC	295
c. Overseas Governments	95

Institute of Freshwater Ecology (IFE)

a. EC	294
b. Overseas Governments	6.3
c. Private Sector	23.4

Institute of Virology and Environmental Management (IVEM)

a. EC	291
b. Private Sector	55

British Antarctic Survey (BAS)

a. EC	149
b. Overseas Governments	14

Plymouth Marine Laboratory (PML)

a. EC	570
b. UN Agencies	52
c. Private Sector	17.5

Proudman Oceanographic Laboratory (POL)

a. EC	285
b. Overseas Governments	8.3
c. UN Agencies	17.1
d. Private Sector	5

APPENDIX 2

Table 1: Summary of NERC Commissioned Research (receipts) 1993-4

£000 1993–94	Total CR	EC	ODA	Other overseas CR*	Overseas contribution to total CR (inc. EC & ODA) %	Overseas contribution to total CR (excl. EC & ODA) %
IH	4,281	155	1,812	269	50.7	6.2
IOSDL	1,165	295	—	331	55.6	28
ITE (N)	3,661	513	360	68	25.1	1.9
BGS	15,245	679	3,628	509	30.7	3.3
ITE (S)	3,089	295	41	95	14	3.1
IFE	1,810	294	—	30	17.9	1.7
BAS	163	149	—	14	100	8.6
PML	2,730	570	—	695	20.9	2.5
POL	1,929	285	—	30	16.3	1.6
IVEM	1,017	291	—	55	34	5.4

* Includes receipts from overseas governments, development banks, private sector.

Professor John R. Krebs FRS

Chief Executive

27 May 1994

Evidence from the Science and Engineering Research Council (now EPSRC and PPARC)

In my letter of 1 March, I provided an SERC view on the initial points you raised in connection with this enquiry. I now enclose a response to the questions contained in the formal Call for Evidence.

You will be aware that the Science and Engineering Research Council (SERC) will cease to exist on 31 March, when it will be replaced by the Engineering and Physical Sciences Research Council (EPSRC) and the Particle Physics and Astronomy Research Council (PPARC). SERC's current scientific remit will, in the main, be transferred to these new Councils, but our existing interests in biological sciences and biotechnology will be passed to the Biotechnology and Biological Sciences Research Council (BBSRC) which replaces the Agricultural and Food Research Council.

In view of these changes, and noting that the work of Sub-Committee I will continue during the months following the Research Councils reorganisation, the attached submission takes the form of separate statements from those elements of SERC which will form the Engineering and Physical Sciences Research Council and from SERC's Particles, Space and Astronomy Board on behalf of the Particle Physics and Astronomy Research Council. Input from SERC's Biotechnology Directorate will be included in the submission from the Agricultural and Food Research Council.

Dr A E Hughes

Acting Chief Executive

31 March 1994

A. STATEMENT FROM THE SCIENCE AND ENGINEERING RESEARCH COUNCIL ON BEHALF OF THE FUTURE ENGINEERING AND PHYSICAL SCIENCES RESEARCH COUNCIL

1. *What is the extent, nature and variety of overseas investment in UK science? How does this compare with investment by UK interests in science overseas?*

Overseas investment in SERC's Rutherford Appleton Laboratory (RAL) and Daresbury Laboratory (DL) comes from a variety of sources, details of which are provided in the attached annexes 1 and 2. The sources of income range from bilateral agreements between these Laboratories and overseas research organisations, contracts from the European Community (EC), sales of expertise, goods and services and charges for access to major research facilities (eg the Synchrotron Radiation Source (SRS) at DL and the Spallation Neutron Source (ISIS) at RAL).

In the field of Marine Technology, UK engineers are heavily involved in EC programmes such as MAST, THERMIE, JOULE, and BRITE-EURAM—all of which demand that the projects involve at least two countries and require the participation of industry. The UK's Marine Technology Directorate (MTD) has agreements with IFREMER (France), CMO (Netherlands), NRC (Norway) and (shortly) with NSF (USA) for collaborative programmes of research. MTD's experience has demonstrated that a majority of its Managed Programmes (ie jointly funded by SERC and industry) include a large percentage of overseas industrial participants. For example, the MTD "Technology for Unmanned Underwater Vehicles" programme includes among its industrial sponsors Lockheed Aerospace (USA), Mobil Oil (USA) and Simrod O.G. (Norway), all of whom contribute overseas funding.

Overseas investment in UK research in Information Technology (IT) is considerable, complex and spans a diverse range of disciplines. IT, as it applies to SERC's scientific remit, covers science and engineering which assists the manipulation of information in all its forms. Hence the disciplines involved are materials, physics, electronics, mathematics, computer science, computing, communications, control engineering, psychology (cognitive science), linguistics and neuroscience. Overseas companies with some investment toehold in the UK economy in the IT area include Hitachi, Fujitsu, IBM, Sharp, DEC, Northern Telecom, Intel, Sema, Nokia, Ericsson and Philips. Many more smaller companies also have UK bases, if only a sales office. There is a continuous interchange, across UK boundaries of personnel, ideas and equipment, particularly with the rest of Europe, the USA and Japan, but increasingly with the Pacific rim countries and India.

2. *What factors influence potential investors in deciding whether to come to the UK for science, or go elsewhere? (whether elsewhere in the EC, or elsewhere in the world)*

The Strength of the UK science and engineering base and its expertise and innovative capability are the most often quoted reasons for investment in the UK. However, there are a number of other factors at work here. In the case of overseas investment at SERC's Research Establishments, the most significant are:

(a) In some cases we offer access to research facilities that are unique; this is particularly the case with the RAL's pulsed neutron source (ISIS) and DL's SRS;

(b) RAL and DL open the door to collaboration with the UK university sector and international partners value this highly;

(c) British science enjoys a high reputation and is well organised and geared to international collaboration. In addition, the universality of English as the language of science makes it easy for foreign nationals to participate in programmes at UK institutions.

In addition, UK marine technology programmes attract overseas interest because they are designed to be relevant to industry, the academics involved are industry-aware and the research costs are very competitive.

Where reasons are given for not investing in UK R&D, these point to the poor provisions for "pull-through" of university-developed technologies into industry and the lack of incentive on the part of universities to see any resulting technology commercialised (although this is not the case in the marine sector).

3. *What are the benefits to the parties concerned and the wider UK economy? (both short- and long-term, both tangible and intangible—including such matters as training, employment, intellectual property, access to and exploitation of results, one form of investment attracting another)*

A full analysis of the benefits to the UK of inward investment in science has been reviewed in a report commissioned by the Office of Science and Technology (OST) from Segal Quince and Wicksteed which will be of interest to the Committee. It demonstrates that there are substantial benefits to the UK economy from inward investment in science. A very large fraction of international funds spent in the UK materialises in local economies.

There are clear scientific advantages to international partnership. The scope and quality of the science is enhanced because international activities typically attract the most able and innovative scientists. Where European Community funded programmes call for academic and industrial collaborative activity, they offer an opportunity for UK industry to collaborate with foreign academics thus accessing ideas and developments in a pre-competitive arena. Additionally, UK science benefits from enhancements to UK facilities made possible by overseas investment which provides a higher level of service to the UK community. Furthermore, greater user pull is generated from a European and/or global market, for its ideas and innovations. However, without an effective domestic pull-through mechanism the main benefits in terms of economic development often accrue to foreign companies via transfer of technology overseas.

For the overseas partner, the benefits are access to technology and training facilities.

4. *What is the level of expenditure by investors, and are there costs (direct, indirect or intangible) to the hosts?*

The level of overseas investment at SERC's Research Establishments is indicated at annexes 1 and 2. Regarding the supplementary question on the costs to the host site in providing scientific access, the figures in annexes 1 and 2 cover all recurrent costs and attribute appropriate levels of depreciation to the foreign partners. Any indirect costs are therefore covered by the international funding.

An obvious cost of overseas access to UK facilities is the consequent loss of time to UK researchers. It is hard to determine whether the cost of the loss to UK science is outweighed by the benefits (each and other) of the receipt of overseas income. However, it is clear that alpha quality UK science is being affected by the loss.

5. *What are the policy implications for the British government and British science?*

The UK should continue to play a strong part in participation in European R&D programmes and in their planning so that we develop firm partnerships which assist exploitation of UK innovations within Europe. This base should then be used to enter the global market. It is important to develop incentives for the universities to commercialise R&D and to exploit the results where possible.

The status of a UK university department is of importance in attracting inward investment and further consideration should perhaps be given to the mechanism by which departmental grading is assessed. Curently, the status is mainly dependent upon the number and quality of papers published on a research subject. Such a policy can prevent research (and its results) from being taken forward (to produce, for example, demonstrators) because that development does not result in the publishing of papers.

Regarding overseas access to major facilities, there are strongly expressed opinions, particularly in France and Germany, that national facilities should be made available to the international community at no charge. Such arrangements favour a "knock-for-knock" policy for international facilities. In the particle physics area, the International Committee for Future Accelerators (ICFA) strongly advocates an open-house in national facilities for international science. The position adopted by the UK is that non-UK users should pay for their access to UK facilities. This line is being challenged by France and Germany and perhaps European governments should establish an appropriate basis for sharing national facilities. Should this be on the basis of shared costs for all or should national governments meet the full cost of national facilities which would then be widely available for international access? A debate on this issue might initiate the development of a European policy for British science facilities.

Annex 1

RUTHERFORD APPLETON LABORATORY—International Receipts

	1993–94 £k
EC Contracts	2,309
CERN	46
DESY (Germany)	1,496
KfK (Germany)	156
NFR (Sweden)	181
NWO (Netherlands)	322
KEK (Japan)	146
ANSTO (Australia)	138
CNR (Italy)	798
ESA	462
Risø (Denmark)	19
Sumito/RIKEN (Japan)	2,434
ESRF	30
MIT (USA)	116
Overseas Universities	48
Others	18
Total	8,719

Annex 2

DARESBURY LABORATORY—International Receipts

	1992–93 £k	*1993–94* £k
EC Contracts	630	204
Agreements	155	60
Beamtime Sales	28	48
Other Sales	147	670
Total	960	982

B. Statement from the Science and Engineering Research Council on behalf of the future Particle Physics and Astronomy Research Council

Introduction

1. Particle physics and astronomy research requires access to facilities on a scale which countries cannot in general afford on their own, and has therefore become heavily internationalised. Recent UK governments have not sought to attract international facilities to the UK, unlike say France, so the UK hosts relatively few such facilities. The former SERC was, however, successful in attracting partners to share in the costs of major telescope projects originally conceived as national facilities. While such collaborations do not usually involve the transfer of funds from other countries into the UK research programme, there are real, if indirect, benefits to UK science of funding decisions taken overseas. The calibre of British scientists also means that they are sought after as partners in collaborative projects which can represent good value for money for the UK.

International collaborations

2. Most collaborations involve countries pooling their resources to achieve what no single country could achieve on its own. Membership of, for example, the European Laboratory for Particle Physics (CERN) enables UK scientists to undertake research that could not be funded nationally. However, it similarly enables other countries to pursue research. Such collaborations are therefore of mutual benefit to all parties, and could perhaps be considered investments in each other's science programmes.

3. This becomes apparent if there is an imbalance between a country's contribution to a collaboration, and its ability to exploit the collaboration at a national level. Contributions to CERN and the European Space Agency (ESA) science programme are determined on a Net National Income (NNI) basis. These contributions provide for the basic facilities (accelerators or satellites) and their operation. The extent of the scientific return to a country depends on how effectively it can exploit these facilities through the construction of nationally funded detectors and instruments. Countries which do not take a role in such instrumentation in proportion to their NNI contributions are effectively subsidising those which do.

4. A vigorous involvement in the instrumentation programme also enhances the research output of national groups from the completed facility through the familiarity it gives them with the capabilities of the instruments. The strength of UK research in terms of its intellectual content, technological innovation and research training has meant that in the past it has generally been a net gainer in terms of time on facilities and science output from its collaborations. It is important that this favourable balance is maintained, and that nationally funded programmes remain at a high enough level to exploit the international subscriptions.

5. Alongside the core UK space science programme managed through ESA regular invitations are received to contribute to instruments on missions funded by other countries such as the United States, Japan or Russia. These can be very cost effective. For an investment of £1.6 million in an instrument for the Japanese YOHKOH spacecraft, currently studying the sun, the UK will have access to the full data-set from all the instruments. This could be seen as UK investment in Japanese science, since this is their mission, but the access the UK has to the data means that this is also an investment in UK science by Japan of the full cost (around £65 million) of the mission. Similar benefits were achieved with the GINGA X-ray mission in the late 1980s, where an investment of £1 million in instrumentation gave the UK full access to the mission which cost around £23 million. UK scientists won 20 per cent of the observing time, are named on 40 per cent of publications, and now have the use of the full data-set.

UK facilities on overseas sites

6. All the major UK optical, infrared and millimetre telescopes are now sited overseas, since the UK landmass does not provide sites of suitable altitude and quality. All involve some degree of collaboration with international partners. Since the UK is the manager for facilities on La Palma and Hawaii, the partners' contributions of £2.5 million for these facilities are paid to the PPARC and it retains the primary role for their control. This enables the UK to maintain a range of skill, expertise and research that it could not support if limited to domestic funds alone.

International facilities in the UK

7. The Cabinet Office study "Economic Impacts of Hosting International Scientific Facilities" (1993) addressed the costs and benefits of hosting facilities. In particle physics and astronomy there are no opportunities in the short term for the UK to bid to host major new facilities, although it has been successful in bidding to host the Joint Science Operations Centre for the ESA SOHO/Cluster mission. A UK decision to create a national data centre for the mission at a cost of £2.5 million has underpinned the successful bid for the £2 million ESA contract. The Centre will provide a service to the whole agency community, but since it is sited here UK nationals will be able to become familiar with the satellites and their data, which experience shows will enhance UK exploitation of the mission.

Policy implications

8. The foregoing shows that in particle physics and astronomy the concept of international investment in UK science is complex. Much of the benefit is indirect because of the need for countries to pool their resources to build facilities on the required scale, and the possible high return from small shares in the programmes of other countries. The maximum benefit is gained in areas of international collaboration by maintaining an active UK national science programme. This not only ensures that the UK derives its rightful benefit from the collaborations, but also enables it to exploit cost effective minor roles in complementary projects, and can stimulate inward investment.

9. Having identified the collaborations, such as CERN and ESA, in which the UK wishes to participate, it is therefore important to maintain a vigorous domestic programme of an adequate size to reap benefits commensurate with the investment. If the relative volume of the UK domestic programme falls below those of its partners, its investment in the collaboration becomes an investment in the science programmes of those partners.

HIGHER EDUCATION FUNDING COUNCILS

Evidence from the Higher Education Funding Council for England

Thank you for your letter of 31 January. I hope the following answers to the particular issues you raise are of assistance to the Sub-Committee:

1. *How does the HEFCE funding formula reflect university income from international sources (both research grants/contracts and overseas postgraduates)?*

Both the teaching and research allocations of the HEFCE are relevant to the support of postgraduate students. The HEFCE's teaching funding formula takes into account numbers of home and EC students, but not overseas postgraduates. This is because overseas student fees are set on a different basis from those for home and EC students: the level of fees is at the discretion of the higher education institution, and is likely to reflect the full cost to the institution. With regard to the research funding formula, all postgraduate research students, whether home or overseas, are regarded as part of the research effort of the department. Information on total numbers (and studentships) of postgraduate research students is collected to inform Research Assessment Exercises (RAE), and is used in the volume measure to calculate QR funding.

Information on research grants/contracts from overseas sources (split between the categories "EC" and "other overseas") is collected to inform RAEs.

Income from EC research contracts, but not other overseas income, is used within the calculation of the CR element of research funding. The CR element encourages, in particular, cost recovery by HEIs on contract income. So as not to disadvantage HEIs that attract funds from the EC, EC research contract income is multiplied by a factor of 1.4 to reflect the fact that institutions' ability to attract full costs in respect of this is limited.

However, the funds provided by the Council are in the form of a block grant and it is for institutions themselves to decide how to use these most effectively, including in relation to overseas involvements.

2. *What forms of overseas involvement in English science are you most aware of?*

The Council keeps itself informed generally of overseas involvements in English HEIs, but it would be misleading to single out any of these. The Council's main function is as a funding body, and it operates through formulaic methods: the Council collects information relating to overseas investment and activity in English HEIs, for funding purposes, as set out above.

3. *In your letter, you raised the issue of "the mobility of scientific and technical manpower". Do you mean the "brain drain"?*

There is a nexus of issues which underlie the topical problem of the "brain drain". All countries have many needs which they seek to satisfy through mobility of students and researchers, including: to gain information on developments in research in other countries; to develop their new researchers, including through experience overseas; to recruit very highly qualified manpower in subject areas in which there may be a scarcity of human resources in their own country; and to assist the development of research in other countries, and generally to promote the internationalism of intellectual investigation.

Different countries have very different strategies both with regard to sending their own students or postdoctoral researchers abroad, and to receiving students and researchers from overseas. To give examples of different strategies: countries with few research facilities, or those where students are disinclined (for instance for language reasons) to travel, may in fact put significant funds into sponsoring travel studentships or fellowships. Some countries charge no fees to overseas students, or provide awards, to attract greater numbers; others charge very much higher fees to overseas students than to their own. The different strategies reflect different needs. The Sub-Committee might wish to consider the UK's needs and strategies, in the light of experience in other countries.

We will be considering further what evidence the Council might wish to present in its main submission to the inquiry.

Professor Graeme Davies Feng

Chief Executive

16 February 1994

Letter from the Scottish Higher Education Funding Council

Thank you for your letter of 4 February requesting background information to the enquiry of the Science and Technology Sub-Committee into international investment in UK science; and the invitation to contribute our considered opinion on this subject in due course.

In respect of the amount of international investment in research in Scottish science, please find enclosed details of overseas funds received by the traditional Scottish Universities for subjects categorised as science, engineering or medicine (*not printed*). The former centrally-funded institutions were not included in this survey in 1992; so we do not hold information about the amount of overseas funds received by them for these subjects.

As regards the nature and variety of overseas funds and the uses to which they are put, we do not have this information at the Scottish Higher Education Funding Council. For further information it might be helpful for you to contact the Committee of Scottish Higher Education Principals which covers all Scottish Higher Education Institutions, at St Andrew's House, 141 West Nile Street, Glasgow G1 2RN (Tel 041-353 1880) or the individual Higher Education Institutions themselves.

In response to your question about whether the Council has policies to encourage overseas investment in Scottish science, it is important to make the point that institutions are independent bodies and involvement in attracting overseas investment is, ultimately, a matter for them.

That said, the research funding formula used by the Funding Council does encompass and give credit to external research income, including overseas research grants and contracts. It also takes into account internationally-funded postgraduates in its volume indicator. Therefore, the greater the external income received by an institution, and the more overseas-funded postgraduates at an institution, the greater the funds it will receive from the Council, all other things being equal. It could be argued that this mechanism provides an indirect incentive for institutions to increase their research funding from overseas sources.

I hope that this response is helpful. Please do not hesitate to contact us should there be any further information which we can provide to assist you in your enquiry.

Professor John Sizer

Chief Executive

25 February 1994

Letter from the Higher Education Funding Council for Wales

Thank you for your letter of January 31. I apologise for the delay in responding, but your letter raised a number of issues which I needed to discuss with colleagues and it came at a particularly difficult time, because of the need to give priority to the development of our funding of teaching and research so as to be able to announce the 1994–95 funding to institutions.

My original letter to you was intended to suggest issues which needed to be raised in consultation with institutions. Inevitably much of what I and my colleagues have to say in response to the questions posed in your January letter will be based on anecdotal evidence, except for the first and last questions.

1. *How does the HEFCW funding formula reflect university income from international sources? (both research grants/contract and overseas postgraduates)*

Two of the four elements of the HEFCW funding methodology for research reflect Higher Education institutions' income from international sources. These are QR and CR, which together account for 92 per cent (89 per cent QR and three per cent CR) of the Council's recurrent funds for research.

QR allocations are made by applying a funding scale derived from the 1992 RAE quality ratings to measures of the volume of an institution's research in a particular unit of assessment. Overseas postgraduate research students and research assistants are included in the volume measure. The volume measures from the 1992 RAE data are: research active staff, weighted 1.0; research assistants weighted 0.1; postgraduate research students, weighted 0.15; no differentiation is made between overseas and home students.

CR funding is made to encourage institutions to undertake contract work on a cost recovery basis. It is calculated from qualifying income which includes EC and other overseas income.

2. *What forms of overseas involvement in Welsh science are you most aware of?*

Inevitably my answer to this question will be highly selective based on the fortuity of information from institutions. One of my colleagues has cross-checked recently with the University of Cardiff since we are aware of the transfer to Cardiff of the base support for the ocean drilling programme. This is described in the college report in the following terms:

> "The Ocean Drilling Programme is the largest and most successful international earth sciences programme ever undertaken. Its ship, the Joides Resolution, with its combination of advanced drilling technology and state of the art laboratories, can support research into long-term changes in global climate, development of continental margins and their hydrocarbon potential and the formation of minerals.
>
> Following a successful bid to the Natural Environment Research Council, the scientific co-operation of the ocean drilling programme for 1995 and 1996 will move outside the US for the first time in the

project's 25 year history. The Marine Geosciences group in the Department of Geology will host Joides Scientific Planning Office from October 1994. A recent expedition discovered a number of mud volcanoes on the sea bed south of Crete which has aroused the interest of Oil Companies."

Other examples in Cardiff include a £3 million investment by Proctor and Gamble in the Common Cold and Nasal Research Centre in the Department of Physiology. The funding came through Proctor and Gamble Europe, but originates in the US. I believe part of the motivation here is that US firms can get more research for their money in the UK than in the top US research universities.

Another example is the School of Engineering's work on wing panel design computer programmes with BAe. More recently NASA has become involved with this and the School's software is now increasingly widely used in the aerospace industry by companies like Boeing, Rockwell and Northrop.

3. *Can you suggest particular sectors where overseas investment may be "filling the gap" left by under-investment by UK industry?*

Perhaps a striking illustration of this is provided by the article taken from the *Independent* on Thursday last which I append to this letter (*not printed*).

Colleagues from the WDA point out that on a number of occasions investment has come from overseas into areas where there is little or no UK industrial activity and it may be that that is one of the factors behind the story in the *Independent.* It is interesting to note that a project in thermal-electric technology at Cardiff which has been offered in the United Kingdom was unable to attract long-term investment. The developer has now been invited to bid for NEDO-MITI long-term investment and is developing strong links with the Japanese steel industry with a view to their investing in the technology.

4. *Can you give examples of inward investment in research leading to other forms of inward investment?*

We have talked with the WDA about this, but they have not been able to provide us with specific examples of inward investment of this sort, although I am sure it exists. What we do know in Wales, where considerable efforts have been made to attract overseas industrial investment along the M4 corridor in particular, is that a research environment is an important marketing support. Much of the inward investment into Wales has been in the field of consumer electronics, telecommunications and automotive industries. As part of its marketing aim the WDA has established a number of "centres of expertise" in Wales and also publishes Advances Wales.

I enclose illustrations of these (*not printed*) and you may be interested to know that the third number of Advances Wales had attracted over 500 enquiries within a few weeks of its publication.

5. *You say that the question of overseas postgraduate students raises "a whole range of issues". Can you elaborate?*

Overseas postgraduate students come to the United Kingdom for various specific reasons. In science it may be because they wish to work on a particular area where a particular individual has an international reputation. In other areas it may be that they are attracted by the overall quality of the reputation of an institution or a subject sector within it, or because there are particular cultural links. Overseas educationalists coming to do postgraduate research in education would be an obvious area where cultural links are a major factor.

From the point of view of institutions, overseas students may on occasions represent a significant addition to the intellectual resource available to a scientific programme. There are a variety of reasons for this, including the innate ability of the individual, the experience which he brings with him from his own institution, the opportunity he presents to make overseas links and so on.

However, one should not underestimate other reasons which are not so closely related to the capacity of the overseas postgraduate student to increase the intellectual resource available to the science base in the institution where he studies. Increasingly during the last ten to fifteen years overseas students have become a major factor in the economy of British universities. This is because of the high fee income which they bring with them and this has to be set against cycles of growth and relative decline in government funding of universities. During the 80s this source of income became increasingly important to a very large proportion of our HE institutions. At the same time the increasing emphasis on research selectivity and the impact this has had on funding, has made institutions conscious of the need to develop their research base. In so far as research students are included as a volume factor (and on occasions in the past they have actually had an impact on the qualitative assessment of a science programme in a university) there have been additional reasons prompting institutions to increase their numbers.

I hope the above comments are of some help to you.

Professor John Andrews

Chief Executive

14 March 1994

REGIONAL DEVELOPMENT ORGANISATIONS

Letter from the Invest in Britain Bureau

You wrote in July querying whether your impression that Wales has a more developed regional policy for international investment in science than other parts of the UK was a correct one.

My Scottish colleagues wrote to you on 4 August expressing a dissenting view—with which I concur. The points they have made show them in no less favourable light than Wales and need to be reflected in the Committee's Report. My Northern Irish colleagues will be writing shortly.

The reality is that most regions of the UK play to their strengths and try to capitalise on their university links, for example. The points made by Scottish Enterprise apply therefore—*mutatis mutandis*—to the rest of the UK.

Of the regions of England with promotional agences, I believe the North West to be more active than most. In the South East—a favoured location for R & D—there is no umbrella organisation promoting the region, but we know that individual universities and science parks are very active. Their international standing is high and they find it easy to get an overseas hearing. All of them have development officers focusing on international relations and investment. Oxford, Cambridge, London, Edinburgh and Manchester are, we think, the most active and successful UK Universities.

My Welsh colleagues are to be congratulated on their efforts to promote their region but I would not go so far as the draft as it now stands. The draft paragraph 4.51 might be modified along the lines "One part of the UK which has a highly..... is Wales". You could with justice go further and add "but others, notably Scotland have their strengths". The report might then go on to give some examples, in a more balanced way then now. Subject to their response these could include Northern Ireland.

I enclose some notes on recent UK national inward R & D investment successes. Remember that, as with all investment projects, many regions may compete to attract the project to the UK but it can usually settle in only one of them. There is always a national dimension to any decision to locate in a specific area.

UK National R&D Successes

UK Software Industry

One important factor for the future growth and development of the software industry in the UK is the co-operation between industry and academia.

Recognising this, the UK government is keen to bring research closer to today's market needs and ensure that software projects are developed with commercial objectives in mind. This type of co-operation can maximise the full potential for research to act as a catalyst for the formation of new product-based manufacturing companies.

A number of software companies have taken advantage of the various government schemes supporting collaborative research in the UK.

The Government has revealed plans to increase funding for university research which is directly relevant to commerce and industry. The 1994 budget from the Department for Education for English universities alone was £618 million.

An initiative has been launched by Scottish Enterprise to harness the expertise of industry, academia and the public sector in translating software ideas into profit-making products and companies.

The Academic Software Initiative aims to act as an intermediary between academia and commerce identifying potential projects and matching them with an industry need.

It has already gained the commitment of Scottish universities and several multinational organisations including SmithKline Beecham, Glaxochem and Shell Exploration.

John Field from the Scottish Enterprise software group said: "Businesses are often crying out for software without any means of knowing that what they need is already under development at an educational establishment."

Tony Hoare from the Programming Research Group in Oxford said: "The relationship between academia and industry is very good and a lot of work has been done to further software developments."

IBM's Development Laboratory at Hursley has worked closely with the Programming Research Group. Between 1982 and 1992, they joined forces to work on a project looking at how to apply formal methods to improve the quality and reliability of large-scale transaction processing, such as systems for airline reservations. The project was awarded the Queen's Award for Technological Achievement in 1992.

Case Studies

(a) Ford

The company is to invest £14 million in two new test facilities at Ford's Dunton research and engineering centre near London.

The investment will enable engineers to study how extended mileages and low temperatures affect exhaust pipe emissions. The Cold Development Centre and the Mileage Accumulation Centre will play a key role in product development, especially now that Dunton has been designated part of the European Vehicle Centre under Ford's realignment programme, with a worldwide responsibility for designing and developing light and medium cars.

(b) Nissan European Technology Centre Ltd (NETC)

NETC, established in the UK in 1988, is dedicated to the design and development of vehicles to be manufactured at Nissan plants in Britain and Spain. Officially opened in 1992 by Lord Reay it marked Nissan's full integration as a European automotive producer.

NETC is a crucial element of Nissan's European dimension, generating the designs for new models and enhancing existing models for the European market. As a European company, NETC is in the best position to know and understand the local market and to utilise the design capabilities already available in Europe. Its location near the heart of the UK and European motor components industry allows close liaison and simultaneous engineering with suppliers from the earliest stages of new vehicle development.

NETC conduct dynamic and durability testing of vehicles and components and act as the contact point for design and production development for Nissan Motor Manufacturing UK Ltd production and conduct all related follow-up activities. Areas of speciality include body, chassis, electrical, engine and trim design, component experiment, trial vehicle assembly and project control.

In today's world companies need to have a global approach to their operations. Nissan has taken this on board and is now designing products in Europe specifically to meet local tastes and needs.

(c) Vidamed Inc

The Californian company has invested £5 million in setting up their greenfield plant in Plymouth in June 1993. The investment was expected to create 193 jobs.

One of the reasons for Vidamed's decision to locate in this region was the close proximity of both Derriford Hospital and the University of Plymouth's postgraduate medical school which offered excellent opportunities for ongoing medical research and monitoring product development.

Vidamed has developed a revolutionary device for treating enlarged prostate glands. Its unique dilatic catheter can be inserted without the trauma of traditional surgical methods to treat the problem gland with electrical waves which shrink the prostate.

(d) ClinTrials Inc

This US company established a facility at Maidenhead in 1993, which has now become ClinTrials' European HQ.

The company, which hopes to employ 150 people by 1996, designs and performs high quality clinical trials for the UK pharmaceutical device industries. ClinTrials will undertake all aspects of a clinical trial, finding suitable participants, monitoring the test and statistically analysing the results.

Thus far the UK operation has been very successful. IBB assisted the company in finding suitable premises.

(e) Sharp Laboratories of Europe Ltd (SLE)

Sharp Corporation is one of the leading Japanese companies in the electronics sector with a strong reputation for innovation. Its first major investment in the UK was in 1984 when it set up Sharp Electronics (UK) Ltd in North Wales, manufacturing video tape recorders.

SLE was established in 1990 and was based at Abingdon before moving to Oxford Science Park. The official opening ceremony was conducted by the President of the Board of Trade, Michael Heseltine in 1992.

SLE has five main aims:

(i) to generate creative technical ideas and provide Sharp Corporation with new and advanced technologies for future products.
(ii) to undertake state of the art research programmes in fields which are important to Sharp Corporation.
(iii) to establish a role at the centre of Sharp's innovation activities in Europe.
(iv) to be accepted as part of the scientific community in Europe.

(v) to contribute to increasing knowledge of advanced science and technology for the benefit of everyone.

Christopher Priston

Deputy Chief Executive

30 September 1994

Letter from Scottish Enterprise

Further to your letter of 4 February 1994, with apologies for the delay in response, I trust that the following answers the questions you pose.

Scottish Enterprise's inward investment arm Locate in Scotland increasingly operates what it characterises as a niche marketing strategy. This targets sectors which can be understood as "science" based. These include optoelectronics, software, biotechnology and healthcare and a number of other technology sectors in which Scotland has a deservedly high reputation and which present the opportunity for investment. This strategy has already achieved modest success. For example, Fujisawa, the Japanese pharmaceutical company established an Institute of Neuroscience in tandem with Edinburgh University. More recently, from the United States we have seen another pharmaceutical company, VRG, set up a clinical trials centre at Livingston New Town near Edinburgh. And only last month Edinburgh University was chosen as the site for the Cray Supercomputer against intense competition from other British universities. However, of these only Fujisawa comes close to the description in your guidance notes as a "science" based inward investment.

Many other universities do have research contracts with foreign companies.

Finally, I have attached as an Appendix to this letter a listing of inward investments to Scotland since the creation of LIS in 1981–82.

Inward Investment

Inward investment in Scotland planned by companies totals some £5 billion since the inception of Locate in Scotland in 1981. These plans have been associated with the intended creation or safeguarding of over 96,000 jobs. [For a variety of reasons, actual investment and job achievement have varied as plans have changed, and many of the projects concerned have yet to be completed. Experience suggests, however, that on average the final direct employment outturn may be about two-thirds of the planned level, although a significant number of additional jobs are also created indirectly in supply and services industries].

Crawford W. Beveridge

Chief Executive

14 March 1994

INWARD INVESTMENT STATISTICS

	Number of Projects	*Cumulative*	*Planned Investment (£m)*	*Cumulative*	*Planned Jobs (New and S/G)*	*Cumulative*
1981-82	32	32	237,370	237,370	7,002	7,002
1982-83	46	78	186,545	423,915	5,327	12,329
1983-84	54	132	166,541	590,456	6,906	19,235
1984-85	68	200	682,974	1,273,430	9,271	28,506
1985-86	58	258	561,840	1,835,270	8,217	36,723
1986-87	50	308	427,163	2,262,433	5,084	41,807
1987-88	84	392	324,167	2,586,600	11,219	53,026
1988-89	55	447	437,629	3,024,229	7,089	60,115
1989-90	64	511	852,611	3,876,840	12,289	72,404
1990-91	63	574	394,136	4,270,976	10,244	82,648
1991-92	59	633	380,945	4,651,921	6,002	88,650
1992-93	65	698	351,956	5,003,877	8,059	96,709
Total	698		5,003,877		96,709	

Letter from Scottish Enterprise

Thank you for your letter of 15 July, which I received on return from holiday.

I am disappointed and somewhat surprised by the impression which you have gained that Scotland does not have a sophisticated and successful framework for both encouraging international investment in Scottish

science and making best use of the science base to the advantage of indigenous companies. Both the statistics and the actual framework of support provided by Scottish Enterprise (SE), the Higher Education Institutes (HEIs), the Scottish Office and others, clearly refute this.

US Manufacturing Investment Abroad for 1992, published recently by Ernst and Young, placed the UK at the top of the European league table, with 18 investments in new plants, of which eight were in Scotland, making it the top location within the UK. This was achieved despite ever increasing competition from around the world for FDI and the global recession. The figures for inward investment into Scotland for the year to March 1994, based solely on projects handled by Locate in Scotland (LIS) and the Scottish Office Industry Department (SOID), show that Scotland secured 95 projects involving total planned investment of £587 million by the companies concerned.[1] If fully implemented, these projects are expected to lead to the creation or safeguarding of 11,072 jobs. This compares to 8,059 jobs in 1992–93.[2]

From North America, Tandem established operations next to Stirling University and intends to take advantage of the software and electronics expertise available in the institution. Haemonetics, following a world-wide search, established a plant for the making of automated blood processing equipment in Lanarkshire, quoting the links with local universities as a major factor in their location decision. Digital Equipment Ltd re-located its complete high end product range, based on the new alfa chip, to Ayr from Galway in Ireland. From the Asia Pacific area, Seiko Instruments established their European production and development facility for optical fibre in Livingston—in part, this reflects the internationally recognised excellence of optronics research and development in HEIs and industry. PCI from Singapore, a world leader in telecommunications contract manufacturing, announced the development of its R&D and manufacturing plant in East Kilbride. Further major investments by established companies, such as Motorola, Seagate, Aortech, OKI, RCMS, etc, reflect the increasing recognition of the importance of science and technology to longer term competitiveness.

Such successes are not new or unusual. Scotland has a reasonable record by UK standards in attracting and retaining projects that have a high R&D content—eg the AT&T (formerly NCR) self service terminal design and development operation in Dundee, Fujisawa Institute of Neuroscience in Edinburgh, Perry TriTech design and development of remotely controlled underwater vehicles, Minebea Electronics, IBM corporate design responsibility for monitors, etc. Much of this success is linked to the excellence of Scotland's science base in key sectors and the ability of the support framework in Scotland to help companies make best use of it.

We cannot, however, afford to be complacent. Global competition for FDI, particularly R&D based projects that have the highest local multipliers, is fierce. The increasing trends towards rationalisation in companies and "jobless growth" mean that Scotland must increasingly marshal its intellectual strengths to compete in increasingly important high-technology industries such as biotechnology, health care, software and optoelectronics, as well as maintaining our leading position in information systems and telecommunications. Indeed, we have been strongly committed to supporting science and technology based economic development for many years. Between 1982–83 and 1992–93, for example, the Scottish Development Agency/SE invested some £91.7 million in science and technology policies. This included the development of:

Science Parks, targeted at the attraction of technology based FDI projects, such as:

- Aberdeen Science and Technology Park and Offshore Technology Park
- Riccarton Research Park (Heriot-Watt University), Edinburgh
- St Andrew's Technology Park
- Stirling Innovation Park
- Dundee Technology Park
- West of Scotland Science Park, Glasgow
- Lanarkshire Medipark
- Bush Technopole, Edinburgh.

Financially supporting the establishment and development of Centres of Excellence, such as:

- Strathclyde University Incubator
- Glasgow University Biotechnology Incubator
- Scottish Assemblies Technologies Centre, Napier University, Edinburgh

[1]The figures for planned investment and jobs are those provided by the companies concerned at the time of the investment decision. Company plans are of course subject to change and some projects may fail to meet job forecasts, while others may exceed them. Evidence over a period of years suggests that, on average, around two-thirds of planned direct jobs are achieved. A significant number of additional jobs are also created indirectly in supplier companies.

[2]LIS collates and uses statistics in a very precise way. Projects in which neither LIS nor SOID were involved are not included, nor are projects where the inward investment takes the form of an acquisition of an indigenous company or a joint venture with such a company.

— Artificial Intelligence Applications Institute, Edinburgh
— Petroleum Science and Technology Institute, Aberdeen
— Cray Supercomputer Facility at Edinburgh University[3].

The Research Councils continue to invest substantial amounts of money in Centres of Excellence in Scotland, in recognition of the quality of research conducted here.

Providing direct support to companies to increase the up-take of world class process and product technologies, and the building of closer links with the local science base:

— The Information Technology into Industry Programme
— The Supplier Development Programme
— The Dedicated Inward Investment Training Programme
— The Food Product Development Scheme
— European Commission R&D Assistance Fund
— Euroinformation Centre/Value Relay Centre (Glasgow)
— Targeting Technologies (Glasgow Development Agency)
— The Technology Support Unit (Grampian Enterprise)
— Etc

More recently, SE, in partnership with the private sector, has been establishing forums in key sectors. These forums underline the importance of innovation to the competitiveness of companies and the absolute need to make much greater use of the indigenous science base, both in attracting inward investment and in supporting the development of indigenous industry as markets become global. The following forums have been, or are being, established:

— Scottish Electronics Forum
— Scottish Innovation Forum for Oil and Gas
— Optoelectronics Forum—part of SE's Optoelectronics Strategy
— Biotechnology Task Force—part of SE's Biotechnology Strategy
— A major part of SE's resources will, over the next three years, be devoted to significantly increasing the birth rate of new firms, with particular emphasis being given to science base spin-offs and other technology based start-ups. The net effect of this on the Scottish economy will be substantial.

In recent years Scottish HEIs have also been taking a much more direct role in increasing the levels of international investment in their science by:

Marketing and selling their consultancy expertise in overseas markets:

— SCOT Innovation and Development Ltd—Scottish College of Textiles
— Napier Ventures—Napier University
— Aberdeen University and Industrial Research Ltd (AURIS)
— UnivEd Technologies Ltd—Edinburgh University
— Research and Development Services—University of Strathclyde
— CAROS International—The Scottish Agricultural Research Institutes and the Scottish Agricultural College

Developing research links between Scottish HEIs and overseas companies, agencies and governments:

— In artificial intelligence between Edinburgh University and Hitachi, Matra Aerospace, CRI, AT&T, etc
— In the human/computer interface between Edinburgh and ATR, a Japanese Government/industry partnership, Apple, etc
— In optoelectronics between Heriot-Watt and Boeing Defence and Space Group, etc
— In offshore production between Heriot-Watt and Chevron, Enterprise Oil, etc
— Etc[4]

[3] Scotland has a great many Centres of Excellence and the above are only a selection. SE produces a bi-annual listing of all R&D projects being undertaken by HEIs in Scotland—"The Scottish Business of Knowledge—a profile of the interaction between Scottish universities and business". This information is used extensively by LIS in preparing customised briefing packs for potential inward investors and for the generic targeting of companies in priority sectors. This data tool is widely recognised as a source of competitive advantage for Scotland in turning FDI prospects into real projects.

[4] Scottish HEIs have always generated substantial income from contracts with non EC overseas sources. Information from the HEIs' Annual Reports would suggest that this income has increased significantly in the last five years—SE "Evaluating the Impact of Science and Technology Policies and Programmes on the Scottish Economy", PACEC Ltd, July 1993.

Scottish HEIs are also heavily involved in both KNOWHOW and EUREKA programmes, and are particularly adept at successfully bidding for R&D projects. These projects generate substantial income for HEIs' in Scotland and strong links are developing between Scottish HEIs and HEIs and companies throughout Europe and the Eastern European States. A particularly good example of this are the links developed between Strathclyde University and the Polish Academy of Science, with especially strong links with the technical University of Lodz, going back over 27 years.

As you can see, we in Scotland are strongly committed to making the best use of our science base, both through the attraction of appropriate foreign direct investment and the development of an effective framework for the greater use and commercialisation of science by new and established indigenous companies. To underline this commitment, SE will, in the near future, be adopting a new Innovation Strategy for Scotland. This Strategy will completely overhaul the current SE support framework, integrate network activities and focus resources on 10 strategically important areas for action. It is our belief that the implementation of this strategy over the next three years will provide Scotland with one of the most sophisticated and effective regional frameworks anywhere in the world for the generation of science, technology and innovation based economic development.

I feel confident that this letter will give their Lordships a much more accurate picture of Scotland's sophisticated and effective framework for encouraging international investment in Scottish science, and for making best use of the science base to the advantage of indigenous companies. We are, of course, always striving to improve our performance, as our new Innovation Strategy clearly demonstrates.

Crawford W Beveridge

Chief Executive

Memorandum from the Welsh Development Agency

Q1. *Does the Welsh Development Agency have particular policies or actions on inward investment in Science?*

1A. The Welsh Development Agency (WDA) actively promotes inward investment to Wales through Welsh Development International, the inward investment division of the WDA.

In particular, inward investment in science is encouraged through the R&D Initiative (Appendix 1—WDA Technology Business Plan 1993–94).

The R&D Initiative has focused on working with existing inward investors who already have manufacturing facilities in Wales. The WDA aims to develop links between businesses and the academic sector in Wales and to encourage the inward investors to carry out research, development, design and process development activities in Wales.

The WDA is also active in attracting new inward investors in certain high technology sectors and believes that it is best to focus those activites on these sectors where Wales has unique strengths. These include telecommunications, consumer electronics, automotive components, medical devices and advanced materials. The electronics and information technology sectors are targeted through IT Wales—a working group comprising industry, local government etc.

Work is currently in hand to target the medical equipment sector in Japan and North America.

The WDA helps Welsh Universities and Colleges to market their technology to businesses worldwide and has produced Research Wales (Appendix 2), a directory of academic expertise and Advances Wales (Appendix 3), a quarterly technology transfer journal highlighting technology opportunities from Wales. Advances Wales is distributed to major organisations in over 40 countries and in its first year, has resulted in several hundred opportunities for collaboration between Welsh organisations and companies overseas. These activities play a key role in establishing links between businesses and academia in Wales and also have some spin-off in raising the profile of Wales to the inward investment market.

The WDA encourages and supports the formation of industry clubs which have participation of indigenous and foreign owned companies. These clubs help build links between indigenous businesses and inward investors. In the medical sector, the Welsh Medical Technology Forum is now well-established and is seeking more formal links with similar networks in North America and North Italy.

The WDA has a team of technology specialists who can provide support to science based inward investors.

The WDA's property development programmes includes some facilities specifically aimed at science based commercial activity, such as incubator units, science parks and innovation centres. These are mainly aimed at providing facilities for locally based businesses but do provide some attraction to inward investors.

Q2. *Are you aware of particular sectors or pockets of significant overseas involvement in science in Wales?*

2A. Many of the inward investment companies initially establish manufacturing bases in Wales and then, after a period of several years, will introduce complementary product design, development and research activities in the Principality. For example, research into digital TV by Sony and the establishment of a European Technology Centre for Calsonic.

Research and development activity by inward investment companies, tend to be in the areas of consumer electronics, telecommunications, medical devices, new materials and automotive components.

The WDA is actively involved in encouraging greater participation by companies and academia groups in EU funded R&D Programmes. Awareness of these programmes can be raised via the Wales European Office in Brussels, while proactive help in finding European partners and preparing submissions is provided by the Wales RELAY Centre, which is hosted by the WDA and co-funded by the European Union, Welsh HEIs, Welsh Councils as well as industry (Appendix 4).

The WDA has recently been awarded EU funding to develop a regional technology strategy under RETAS (Appendix 5) and to promote the technopole concept under SPRINT (Appendix 6).

A number of academic groups in Wales have benefited significantly through funding of collaborative research programmes by overseas companies and EC programmes. Details of these activites can be obtained from the submission by the Higher Education Funding Council for Wales.

Q3. *What information can you provide on the scale of inward investment in Wales, and on trends?*

3A. The most recent analysis of inward investment in Wales is contained in the Welsh Economic Review, abstract attached (Appendix 7).

Appendices not printed.

REPLY TO ADDITIONAL QUESTIONS IN YOUR LETTER DATED 25 MARCH 1994 TO MR DAVID HARRIS

1. *Four Motors Link*

The Welsh Development Agency's activities with the Four Motor Regions are primarily through the Eurolink Programme.

Ron Loveland or Philip Bird of the Welsh Office would be able to advise you on the formal Wales/Four Motors Links.

Eurolink is one element of the overall programme. Eurolink activities in the Four Motor Regions commenced in 1990 in Baden Wurttemberg and since then, working relationships have been established with the other regions. The fundamental objective of the Eurolink programme is to promote collaboration between Welsh companies and European partners.

2. *Proctor & Gamble*

Proctor & Gamble's links with Cardiff relate to their funding of the Common Cold and Nasal Research Centre at the University of Wales, College of Cardiff, which is directed by Dr R Eccles. The relationship with Proctor & Gamble stems from the early 80s when the company first linked with the nasal physiology groups at Cardiff, In 1987, Proctor & Gamble funded the establishment of a volunteer trials faculty and support for basic research and staffing costs. The initial support was further extended and to date the company has provided a total of approximately £2.5 million to the unit.

Dr Virginia Chambers

David Harris

April 1994

Evidence from the Industrial Development Board for Northern Ireland

1. A successful inward investment drive remains crucial for Northern Ireland with the introduction of new internationally competitive companies bringing benefits of new technologies, skills, markets and jobs. The Department of Economic Development (DED) has a pivotal position in this development through its departmental agencies—the Industrial Development Board, the Industrial Research and Technology Unit, and the Training and Employment Agency. The Department of Education and the NI Higher Education Council also perform very vital roles.

2. *Industrial Development Board (IDB)*

2.1 IDB seeks to attract inward investment in manufacturing and tradeable services and is particularly keen to attract investment involving R&D functions, science and technology. It is recognised that the direction and future of manufacturing industry is increasingly being determined by technological developments and it is therefore vital for the future of the NI economy that it continues to attract investment in science and technology. In presenting Northern Ireland as a prime inward investment location for these functions IDB points to the strength of the current educational and technological infrastructure and support. Examples of particular recent successes are set out in Annex 1.

3. *Industrial Research and Technology Unit (IRTU)*

3.1 In Northern Ireland the centrality of R&D, technology transfer and innovation to overall regional development and wealth creation have been recognised in the creation, within the Department of Economic Development (DED), of the Industrial Research and Technology Unit (IRTU).

3.2 This relatively new Unit (established in 1992) works closely with the IDB, Training and Employment Agency, and other DED agencies, in addressing the overall economic development of the region. IRTU acts as the focus and catalyst for the promotion of industrial R&D activity, technology transfer and industrial/academic collaboration in Northern Ireland. It works closely not only with the IDB and other DED agencies, but also with the European Union and the International Fund for Ireland in addressing its remits.

3.3 IRTU provides a range of support programmes for both inward and indigenous investors. These range from support for pre-competitive R&D and for market-led product and process development, through technology and environmental audits. The support includes Structural and Framework funding support from the EU; access to national programmes such as the Teaching Company Scheme, SMART and LINK; and the provision of specialist scientific services and advice from the Unit's Industrial Science Centre.

3.4 IRTU's expenditure on its programmes in 1993-94 amounted to £13.8 million.

4. *Department of Education*

4.1 The Northern Ireland Deparment of Education also has a role in the attraction of investment in science and technology. It recognises the important part which universities play in economic regeneration, and in helping to attract international investment. Central to the universities' ability to attract such investment is the provision of centres of research excellence and the demonstrable quality of research undertaken. The Department of Education's primary role, in this context, is as a provider of the funding necessary to enable the universities to provide the facilities where the centres of excellence can develop, thus providing the necessary critical mass of research facilities and staff expertise which international investors require.

5. *Northern Ireland Higher Education Council*

5.1 The Northern Ireland Higher Education Council, established in 1993 to advise the Department of Education on the planning and funding of higher education, also fully recognises the importance of encouraging inward investment in R&D in NI, and plays a key role in promoting improvement in the quality of research which enables both universities to attract such investment. The Council works closely with the local universities in the development of strategies for research which take account of these principles and is responsible in particular for the provision of advice on the allocation of a NI developmental element of research funding (NIDevR). Totalling some £7.6 million in 1994–95, NIDevR is directed towards bringing about an improvement in the quality of research undertaken in NI and sustaining and developing the university research base in ways which reflect and respond to the economic, social and cultural needs of the community. It is intended to encourage both an increase in the levels of research funding earned by each university, including funding received from sources other than Government, and an improvement in links with other partners.

6. *Direct University Involvement*

6.1 Links in Northern Ireland between business and academic worlds are closer than in most communities. Queen's University of Belfast (QUB) has won a worldwide reputation for its medical, engineering and science faculties. The University of Ulster (UU), with its campuses at Coleraine, Londonderry and Jordanstown near Belfast, has a strong reputation in a number of fields of physics and computer science. In other areas, particularly engineering, the research work is very much geared to the needs of industry.

6.2 It is standard practice for the Industrial Development Board to introduce serious potential investors to the university network. This has a very positive impact on convincing the investor about the science and technology credentials of Northern Ireland.

7. *General*

7.1 There is a clear awareness in Northern Ireland of the importance and value of investment based on science and technology. A number of public sector bodies are co-operating to raise further the level of application of science and technology in the industrial development scene with the beneficial consequence of

making the region more attractive to new inward investment. Northern Ireland will continue specifically to target science and technology based investment as an important element of industrial development strategy.

Annex 1

INVESTMENT IN SCIENCE AND TECHNOLOGY: EXAMPLES OF RECENT NORTHERN IRELAND SUCCESSES

1. The recent attraction to Northern Ireland of major technology and R&D investment projects by manufacturing companies:—

	Company	*Product*	*Location*
(a)	Seagate Technology, USA	R&D Centre	Londonderry
(b)	Seagate Technology, USA	Disk Drive Heads	Londonderry
(c)	Du Pont, USA	R&D Centre (Kevlar)	Londonderry
(d)	Du Pont, USA	R&D Centre (Hypalon)	Londonderry

2. NI has benefited from the establishment of twelve infrastructure projects under the EC STRIDE mechanisms, covering, inter alia, the fields of composite materials, computing, telematics, aerospace engineering and environmental technology (these projects are valued at £10.5m in EU support terms but also lever approximately £10m from regional industry/academia).

3. The STRIDE project has facilitated the establishment of commercial linkages between various faculties in the two regional Universities and such companies as ICL, GEC, Bell Northern Research, National Semi-Conductor, Analog Devices, Merck Sharp & Dohme, DEC, Eli Lilly, Pfizer, Fujitsu, Kobe, Exxon, Ferrari, Yamanouchi, Hitachi, Yamaha, Kawasaki, 3M, Brunswick Bio-Medical Corporation—and with companies with a strong regional presence such as Du Pont, Shorts, Northern Telecom, Ford and British Telecom.

September 1994

COMPANIES

Letter from Bayer plc

Your letter of the 21 March has been passed to me for reply, which is as follows:—

(1) Bayer plc Pharmaceuticals Division currently employs some 50 people in pre-clinical research (into the treatment of respiratory diseases) and approximately 100 people in clinical research in the areas of cardiovascular, central nervous systems, infectious diseases, diabetes and asthma.

(2) Collaborative research and development has been conducted in the UK for the past 25–30 years.

(3) Some of our basic research is conducted in collaboration with academic departments in British universities, and much of our clinical research is conducted jointly in academic Departments of Medicine.

(4) Bayer conducts research and development in countries where scientific standards and the quality of work is high, and includes North America, Europe, Japan the Pacific rim, Australia and South Africa.

(5) I suggest you contact other large multi-national pharmaceutical companies, eg Glaxo, Merck, Ciba Geigy, Smith-Kline Beecham.

Dr R Wheywell

Director of Research & Development

12 April 1994

Letter from British Aerospace plc

Further to my letter of the 11 April, I now have pleasure in submitting the following views on this topic, on behalf of British Aerospace.

From a company perspective the subject is not one which causes significant concern but we have attempted to give brief answers to each of the questions.

1. *Extent of overseas investment in UK science.*

According to Government statistics, the amount of overseas investment in UK science doubled (as a percentage of total UK R&D funds) during the period 1983–91. In the aerospace sector, the largest overseas investment in UK Aerospace Science probably occurred as a result of the US Strategic Defence Initiative (SDI) programme. Several UK research establishments and universities received SDI contracts but these dwindled as the programme was curtailed.

Several large overseas aerospace companies use some of the best UK wind tunnels to carry out research for them. We believe that the UK has negligible investment in science in other countries.

2. *Reasons for overseas investors to come to the UK for science.*

Many overseas organisations have become truly multinational and are not concerned in which country their research is carried out. Because of the low UK costs they have set up research labs or have put contracts with various universities and research organisations in this country. The other reason overseas investors come to the UK for science is because certain UK establishments are world leaders in their technology and overseas investors wish to acquire or use this technology.

3. *Benefits of investment*

The overseas company benefits by accessing technology cheaply and then takes the inventions or knowledge back to its country to develop and sell products to create wealth for its nation. This wealth can be much greater than the original research contract. Some of the benefits to the UK are that the overheads of the research organisation have been partly covered and the staff are able to develop their skills. It is occasionally possible that the organisation having the research contract could be involved eventually in a potentially large development programme giving significant value to the UK but this would be unusual.

Unfortunately, the down-side is that there is usually technology transfer and a loss of intellectual property from the UK. It would obviously be better for the UK government and industry to have placed the contracts and created the wealth for the UK. It may be of interest to note that government funding of R&D has decreased at about the same rate as overseas investment has increased. (See attached figure.)

4. *Expenditure*

Compared with the scale of total aerospace funding, there is a relatively small amount of overseas investment. The main risk to the UK is that it may transfer its intellectual property to a potential competitor.

5. *Policy implications*

As overseas investment in aerospace research is small it is not considered to be a major problem and there does not appear to be a need for any special policy provision. Nevertheless, it is vital that the UK continues its own investments in research to maintain a viable industry which over the years has produced many tens of billions of pounds of exports.

Some of the reported overseas R&D funding may be misreported by small companies where it is concerned with the international development of major projects. For instance, some parts of UK funding for Eurofighter 2000 may have been wrongly attributed to Panavia (Germany) by small UK subcontractors due to the project funding procedures.

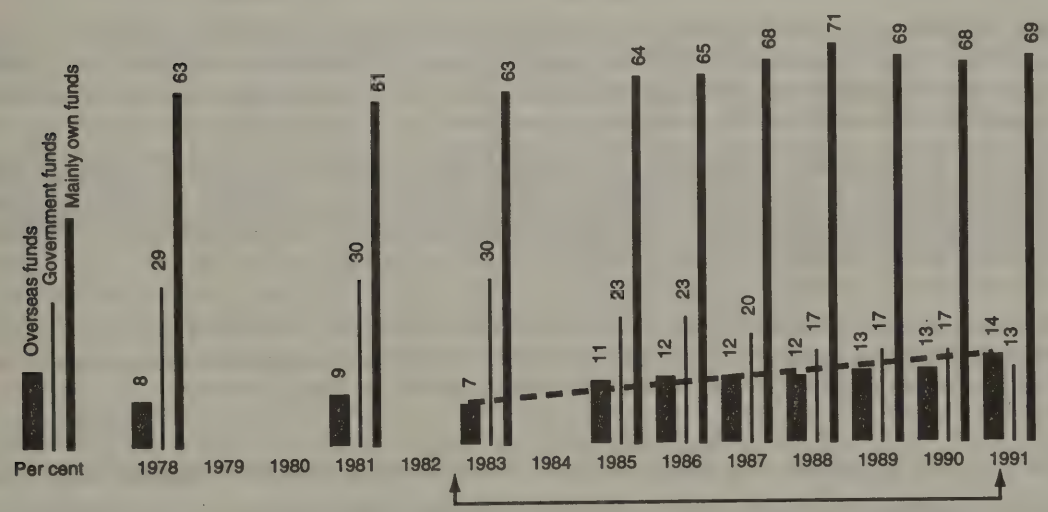
I trust the above remarks are of some value, and would be happy to provide any further clarification.

Trevor Truman

Director of Engineering

18 May 1994

Source of funds for industrially performed R&D (1978–1991)



Evidence from British Gas

1. *What is the extent, nature and variety of overseas investment in UK science? How does this compare with investments by UK interests in science overseas?*

British Gas is involved in a wide range of international collaborative research ventures all of which result, in some way, in inward investment in UK science. They fall into two main categories: International Research Exchange Agreements with non-UK gas companies and collaborative research projects, whether funded independently or by the European Union.

(i) The first category is concerned principally with technology acquisition and the sharing of both scarce facilities and costs with the research arms of similar organisations in Europe, the USA and Japan. Specific agreements are set up to control each of these activities and, where there is common interest, pre-competitive collaborative projects are established. Under the three existing agreements, there are currently in excess of 50 project teams and information exchange groups meeting only once or twice per year.

Net income, and hence investment in UK science, varies across the current programmes. In general, the placement of work is balanced between the collaborators' countries but in areas where British

Gas or British universities excel, there is net income. For example, in one specific technical area where British Gas are world leaders, our collaboration with the Japanese provides an income of around £200,000 per annum.

(ii) British Gas has always been active in collaborative project work both to promote technology transfer and to gain leverage to fund large scale experimental programmes. Recent years have seen an increase in the amount of collaborative R&D as a direct result of the availability of European Union funding to support such work. The current value of contracts placed with British Gas and, hence, the investment in UK-based research from non-EU funded collaborative projects, is in the region of £6m. In addition, British Gas "income" from EU-funded, collaborative research projects is in excess of £2m. The same projects provide ca. £250k to UK universities and ca. £600k to other European universities.

With regard to the suggestion that there may be competition for access to particular pools of expertise, it is British Gas' experience that there would not appear to be shortages either of high quality academic staff or of research institutes available for, and actively seeking, contract R&D work.

2. *What factors influence potential investors in deciding whether to come to the UK for science, or to go elsewhere? (whether elsewhere in the EC, or elsewhere in the world)*

Potential investors, including British Gas, are attracted primarily to research organisations or individuals with reputations for high calibre science and engineering, in specific technological areas, wherever they are located. In addition, they may wish to gain access to facilities which do not exist in their own countries. Generally, however, with the exception of European collaborative projects, British Gas deals almost exclusively with UK universities. However, cost is increasingly a governing factor and it may be the case that investors are attracted to similar, if inferior, facilities which may be available outside the UK.

There, are of course, several factors which may tip the balance in favour of a particular country. Amongst these would be political affiliations, the "old boy" network, including former overseas students now in senior positions in their own countries, and traditional trade links, the last often being extremely influential in determining where research contracts are placed.

Particularly in the case of the European Union, geopolitical factors feature large and, to comply with Commission guidelines, research consortia are inevitably constructed to include a southern European partner. Whilst not necessarily the case, this may be at the expense of technically superior UK organisations, whether an SME, a research laboratory or a university.

3. *What are the benefits to the parties concerned, and the wider UK economy? (both short and long-term, both tangible and intangible—including such matters as training, employment, intellectual property, access to and exploitation of results, one form of investment attracting another)*

4. *What is the level of expenditure by investors, and are there costs (direct, indirect or intangible) to the hosts?*

There are many potential benefits, to all parties, resulting from international collaborative research and inward investment in UK science and engineering.

British Gas' International Research Exchange agreements are valuable in that they help to target resources more effectively by minimising both unnecessary duplication of research and the tendency to "re-invent the wheel". They encourage expert meetings, which often fertilise innovation; they increase the contact base and help to improve international relations, each of which can be a factor in attracting inward investment.

Sharing costs, in collaborative projects, is often the key to initiating work that would not otherwise have taken place. This is certainly the case in major hazards work, which needs large, expensive facilities, and is an area where British Gas is often a beneficiary. In organisations where the emphasis is on short-term results, collaboration and the resultant leverage can allow a longer-term, more strategic approach to be taken to certain technologies and may lead to involvement in pre-competitive collaborations. This is beneficial in that it can provide access to new technologies, to complementary expertise and, potentially, new markets.

Direct external funding into the UK supports research departments by increasing resources, thereby allowing groups to extend their scope and expertise and, in the case of university groups, to develop post-graduate and post-doctoral staff. The outcome is a more active UK research community with a net beneficial effect on employment, albeit small. The funding organisations benefit by gaining access to high quality research staff and resources and by owning the results of the work and, in most cases, the IPR. However, it is increasingly the case that UK university departments are insisting on owning the IPR for externally funded research. Although this is good for the UK where foreign funding is involved, it could be a major disincentive for organisations wishing to place contract research work in this country.

5. *What are the policy implications for the British government and British science?*

UK science is generally regarded as a being of high quality, hence the demand from overseas investors. If the degree of investment from overseas is to be maintained or improved, with net benefit to UK science and industry and the economy, it is clear that the quality must be, at least, maintained.

If there is insufficient national support for expert UK resources, it is inevitable that foreign investment will be sought increasingly, to enable research groups to survive.

If it is the case that there is significant and growing foreign investment in UK science, it can be argued that it is in the national interest to find a compromise between encouraging increasing amounts of foreign investment, and selling the ideas of the UK's best scientists to all-comers.

Evidence from Mr Ian Harvey, Chief Executive of British Technology Group Ltd

Thank you for your letter of 4 February asking me further questions on the letter I wrote to Sally Rodger on the 21 January. Responding to the points raised in your letter:

1 & 2. Foreign companies undertaking research in the UK. Although there may be small R&D units in the UK owned by foreign SMEs, we would expect this to be an unusual activity given the expense of a foreign operation for an SME. Notwithstanding that, one outstanding UK SME we know (Willett International, business–product identification/coding, sales £50 million) undertakes its R&D in the UK, USA and Russia. However, from our own researches, most of the companies come into the multinational or large company bracket.

As examples of this, the principal "foreign" pharmaceutical laboratories that we are aware of in the UK are noted in Annex 1. Via a different route, we have obtained from the Japanese Embassy the names of some of the Japanese companies in the UK which have "R&D" departments. This is attached as Annex 2 (*not printed*). They are all large companies.

You might also be interested in the two articles from the Financial Times—"Globalisation Prompts Exodus" (17.3.1994) and "German Sites for Japanese" (29.3.1994) attached as Annex 3 (*not printed*).

3. Clearly, "he who pays the piper....". But, generally, the unit initiating the research will receive the revenues. Thus we believe, for example, that IBM developing technology in the UK, would credit revenues to the UK/European operation of IBM even though there may be a centralised patents management function for the company as a whole. We believe the same might apply, say, to Ford which has a major research and development facility within the UK. You might wish to check this directly with the companies concerned. Certainly, if you look at the OECD figures for international flows of internationally traded IPR, a substantial proportion of those are royalties paid internally within companies but across borders for use of technology by their affiliates. Thus, armslength relationships in the use of IPR are quite common in multinationals. This reinforces the view that the UK "cannot lose exploitable intellectual property".

4. Electronics (Hewlett Packard, IBM, Sony, Sharp, Philips etc). Chemicals/pharmaceuticals/oil (the pharmaceutical companies I have mentioned plus the oil majors such as Exxon, Shell), biotechnology. This is not an exhaustive list and I suggest that a discussion with the DTI should produce a list of companies undertaking R&D in the UK which should provide a statistically robust view of the areas and the number of researchers working in those areas.

5. Examples of UK companies with significant investment in R&D overseas would include ICI, Glaxo, Wellcome, Zeneca, Pilkington and I am sure there are many others.

6. BTG analogues overseas? There certainly exist "National Research Development-type corporations" in a number of other countries including Japan, Korea etc. If you identify BTG's business as the management of intellectual property arising from research, there is really no organisation of the size, success or international position of BTG. The JRDC (Japan) has a significant number of technologies but it files very few overseas patents, using itself more as a clearing house for technologies licensed to Japanese companies. (Because there are few overseas patents, all those JRDC technologies are freely available for use by any overseas company.) Research Corporation in the United States, although smaller than BTG, operates by licensing university technology mainly to US companies. It is not a proactive organisation—it responds to initiatives from researchers or universities. Its overseas income is quite low, it is not known for defending its intellectual property where it is infringed either in the US or overseas. In the last couple of years, its revenue has increased significantly because of the success of a pharmaceutical product, although we believe its current revenues are still smaller than those of BTG.

The UK is very good at generating value from intellectual property. In the two years 1989 and 1990, UK (mainly BTG) revenues from patenting and licensing principally university technology, were approximately equal to the total revenues generated by the US university and government research systems combined. Even though the US invests roughly five times that of the UK in civil R&D. In the most recent two years, US revenues have increased sharply because the US has relaxed its restrictions on licensing only to US companies and prohibiting exclusive licenses, both of which militate against creating commercial value from technologies. We believe that in the last accounting periods available, the UK was roughly equivalent to the US in terms of dollars of revenue generated per dollar of research and development spent in those sectors.

7. Yes. In a number of cases where technology has arisen in the UK, we have identified overseas licensees in our international licensing programme. We encourage those licensees to invest further money in developing the technology to a marketable product at the research institution where it originated. Usually we (BTG) retain ownership of the resulting IPR—which, of course, the funding company will have rights to. We have a number of such examples.

I would like to put on record the statements that I made in the letter to Dr Rodger. This is attached as Annex 4.

29 March 1994

Annex 1

"Foreign" Pharmaceutical R&D in the UK

Warner Lambert	(US)
Stirling Winthrop	(US)
Syntex	(US)
Eli Lilly	(US)
Merck	(US)
Bristol Myers Squibb	(US)
SmithKline Beecham	(US/UK)
Roche	(Switzerland)
Ciba Geigy	(Switzerland)
Sandoz	(Switzerland)
Ferring	(Switzerland)
Hoechst	(Germany)
Eisai	(Japan)

Annex 4

- R&D is a totally international business such that one cannot restrict the flows of technology—technology will flow to wherever it creates the greatest value.
- R&D is an economic activity (in the service area) like any of the other service industries at which the UK is so successful (UK exports of services in 1992 were $190 billion, manufacturing exports were $148 billion—source: World Economic Forum/IMD World Competitiveness Report 1993).
- In any case, it is very hard to differentiate between "British" companies and "foreign" companies, in that most of the companies in this area are multinationals that decide where to do their R&D or manufacturing based on the competitive advantage of the countries in which they work. Thus, we should no more discourage Sharp from investing in optoelectronics R&D in the UK, than we should discourage ICI from investing in R&D facilities in Japan (which it has done).
- The UK has a comparative advantage in R&D, we are very good at it, the level of expertise available is significant. There is substantial potential for the UK becoming more of a world centre for R&D. However, with growing unemployment in the S&T area (because of shedding of people from the military and government civilian research establishments), we need to encourage economic activity which will increase the market value of scientists and technologists. There is often complaint in the UK that the scientists and technologists go into short-term contracts (with universities) and that they are under-valued by much of (UK) industry. An assessment of scientists in industrial R&D, particularly those paid by foreign companies, in our limited experience, suggests that they are well paid and that it is attractive employment. Equally, currently unemployment amongst science and technology graduates is greater than amongst arts graduates and we need to think how science and technology can create employment for these people. This is one way.
- The companies you mention do not include long-standing companies which have research facilities in the UK eg IBM, Hewlett Packard, both of which have both manufacturing and R&D facilities. One might expect that when R&D facilities are available here, it may be a focus for economic activity which may then grow or be associated with broader economic activity, either in manufacturing or in services but that point would deserve quantitative analysis.
- The UK must focus on high added value activities to maintain its competitive position in the world. To reinforce its R&D comparative advantage in this way will create the kind of "competitive node" that Michael Porter emphasises in creating industrial areas that become competitive on a world scale and attractive to domestic and international investment (eg inward investment in car manufacturing by the Japanese increased the competence of the UK as a car development and manufacturing centre, raising the standards of the other three major manufacturers (Ford, GM and Rover) because of the pool of highly skilled people and competitive forces that are now available in the UK market).
- The idea that the UK will "lose exploitable intellectual property" is an old chestnut but one which needs to be firmly squashed. Early stage ideas usually flow to all those companies which need to use those ideas eg transistors, optoelectronics etc and it is very hard for one country to maintain a

dominant position by excluding other countries or companies. Experience says that a technology can be widely licensed to generate value through royalties for technology of international relevance. However, it is difficult to remove companies from the marketplace through litigation should they choose to use the technology without a licence. This reality is increasingly, but not yet sufficiently, recognised in the UK.

— An interesting subject which you may wish to ponder on is that given the increasing proportion of employment and (probably) GDP contributed by the service industries, where is the technology that the service industries depend on going to arise? The UK has a strong comparative advantage in the service industries, including airlines, communications, publishing, finance and many others. The knowledge of how to use technology, and where to source it, remains an important element of competitive advantage for these service industries. Having leading-edge R&D taking place in the UK increases the likelihood that there will be awareness in the UK of the capabilities of leading edge technology as they apply to our service industries. For example, Sharp Laboratories (Oxford) participate in a collaborative project, Oxford Parallel, which also includes Oxford University and companies such as British Airways and Barclays Bank.

Intellectual Property

The results of wholly company funded R&D undertaken within the UK by foreign companies clearly belongs to the company. It is better to have it done inside the UK than outside.

IPR resulting from R&D undertaken in collaboration with universities may rest with the company or university. In BTG's experience, this IPR may often belong to the university, particularly if significant "background" IPR is involved. Foreign companies, particulary the Japanese are often surprisingly generous in permitting ownership by their collaborators.

In some cases, the IPR is knowhow which will reside in the heads of the researchers wherever they happen to be located or employed—in this case, the UK.

Letter from Ciba-Geigy plc

In response to your letter of 1 February, I am able to provide the following information in regard to the questions that you invited Ciba to consider:

1. *What is the scale and nature of your research operation in the UK?*

Ciba is a leading world-wide biological and chemical group, dedicated to satisfying needs in health care, agriculture and industry with innovative products and services. It aims to satisfy these needs through products originating from its own Research and Development.

Ciba employs around 500 people in R&D in the UK, with a total R&D spend of some £30 million.

Our major fields for research activity in the UK are pharmaceuticals research, agricultural science and industrial chemicals research. This research is intended not only to support Ciba's UK business activities, but to be of benefit to the company's wider international activities.

2. *What is the history of your parent company's involvement with UK science?*

Ciba-Geigy first established a manufacturing base in the UK in 1911, and since that time it has expanded its activities to employ some 5,200 people in 13 different businesses. Its involvement with UK sciences has been continuous and has developed in intensity over the last 80 years. The UK science base has always been seen as strong and a valuable source of creative, exploratory science. For this, and many other reasons, the UK has been regarded as highly attractive for R&D investment.

3. *What relationships do you have with UK academic science?*

Ciba has strong links with UK academic science. These take various forms including:

— participation in research collaborations (especially through the CASE scheme) with numerous universities;
— sponsorship of research work in academia on a contract basis;
— support of leading researchers and research departments through financial donations;
— contracting leading academics as industrial consultants;
— use of testing facilities at academic institutions;
— sponsorship of contract and collaborative joint research with the Medical Research Council.

Such relationships have generally proved beneficial both to Ciba and to the academic institution, and are very highly valued.

4. *What other international R&D operations in the UK should the Committee contact in the chemical sector?*

The 12 international chemical companies listed below should be contacted by the Committee as each has significant involvement with the UK science base.

Hoechst
Bayer
Eastman Kodak
BASF
DuPont
Roche
Dow Chemicals
Rhône-Poulenc
Merck
Sandoz
Pfizer
Schering

I hope that this very brief consideration of your questions will be of some help. Please let me know if Ciba can be of further assistance to the Committee.

E Irving

Director of Central Research

18 February 1994

Letter from Elf Petroleum UK plc

Thank you for your recent enquiry regarding Elf's investment in UK science. I have pleasure in providing the following responses to the specific questions contained in your letter.

1. *Scale and Nature of Elf's UK Research*

The scale of our research is best indicated by our planned expenditure which is £5.5 million in 1994. The scale of our UK research operations reflects the scale of our exploration and production activities; in the UK, Elf is the fourth largest operator.

Elf has established its Geoscience Research Centre (GRC) in London because of the high concentration of research in terms of quality and level of activity in the UK which has an extremely active technical environment. Elf's GRC in London has links to our other research activities throughout the world via our research centre at Pau (SW France).

The emphasis of our research is on geoscience and reservoir engineering.

The majority of our activities are in the field of "applied" research in exploration and production technology. The results of our UK research are applied throughout Elf's worldwide oil and gas activities; similarly, our UK operations are linked to Elf's international research network which enable our UK activities to benefit from research conducted overseas.

Our activities are divided equally between research operated by Elf and research which is conducted under contract on Elf's behalf.

OPERATED research is focused on the central themes of:

(i) the development of tools for improving the description of reservoirs.

(ii) improving the recovery factor from our reservoirs (average recovery for UKCS is about 40 per cent of oil in place).

Elf is also involved with approximately 80 CONTRACTED research projects, most of which are carried out by contractors and universities in the UK. In addition to geoscience and reservoir engineering, our contracted research covers the areas of drilling, marine technology, production technology, environment and safety. The objective of our contracted research programme is to obtain access to relevant technology which is unavailable elsewhere, eg:

— the development of specialised drilling fluids.

— the development of a borehole seismic source.

2. *History of Involvement with UK Science*

Elf's UK research activities began in 1982, since which time the company has invested a total of £36 million. Annual expenditure has risen consistently with a marked increase in 1991 reflecting the significant expansion of Elf's operated exploration and production activities on the UKCS.

3. *Relations with UK Academic Science*

Elf has developed strong contacts with academic researchers by supporting:

— Five PhD students.

— Five lectureships/fellowships.

Elf is a Board Member of the following research organisations:

— Earth Science Committee—Natural Environment Research Council.

— Marine Technology Directorate.

— Scientific Advisory Committee of Petroleum Science and Technology Institute.

— Advisory Committee for Enhanced Oil Recovery Research (DTI).

Elf is also involved in sponsorship of the following:

— University of Aberdeen: Development Trust.

— University of Edinburgh: Safety Engineering.

— Imperial College: Petroleum Engineering.

— Heriot-Watt University: Petroleum Engineering.

— Lincoln College, Oxford: Research Fellowship/Lectureship in Geophysics.

4. *Elf's Worldwide Research*

I have pleasure in enclosing a brochure describing Elf's worldwide commitment to Research and Development.

5. *Other International Research Organisations*

I recommend contacting the UK Offshore Operators' Association which represents the 36 companies with operations in the UKCS. Contact details are set out below:

Harold Hughes,
Director-General,
UKOOA,
3 Hans Crescent,
London SW3.
Telephone: 071–589 5255.

I hope the information supplied will be relevant and useful for your enquiry. Please let me know if you require any further information.

M. Romieu

Managing Director

17 May 1994.

Letter from GEC Alsthom Ltd

Thank you for your letter dated 8 April 1994. My comments in answer to the questions which you raise are as follows:

1. GEC ALSTHOM maintains an engineering research operation in the UK on two sites, totalling 260 persons, of whom some 160 are professional qualified scientists and engineers, around 60 qualified technicians and the balance administrative and support staff. The purpose of this activity is to conduct research into technologies pertinent to existing and future products, to acquire technologies from external sources such as universities, to study the application of those technologies to existing and new products and to resolve technical problems that occur during the commissioning or service of our products.

Specific product design and development is conducted within our various operating units by teams of different sizes, depending upon the nature of the product.

2. GEC ALSTHOM, GEC, and their predecessors, have strong historic links with UK science. At our Rugby site, the first gas turbine was developed during the 1940s and in the 1960s, the first demonstration of holography was also made. We have been instrumental in many of the developments of power engineering

technologies during the last 50 years, mainly through our internal R&D organisations, maintained by the Company for such purpose.

3. Relationships with UK academic science are primarily at three levels:

Individual contacts between our technical staff and academic staff, arising due to their common interests and interactions at conferences.

Formalised links with universities, through the support of research studentships, undergraduate and postgraduate training courses and participation in industrial advisory bodies. We estimate some 20 such links are current.

Support to the research councils, through the provision of members for their advisory and peer review bodies and by the refereeing of research grant applications on behalf of the councils. It is difficult to estimate the number of people involved, but it is probably in the region of 20. One of our staff was chairman of the SERC's Engineering Research Commission until its dissolution this month, consequent on the research council reorganisation.

4. A substantial amount of our R&D is conducted in France. When GEC ALSTHOM was formed, there were considerable R&D facilities in France, primarily supported by government funded product developments. This has continued and in order to take advantage of such funding (normally tied to expenditure in France), we maintain technically comparable facilities in the two countries although those in France are larger.

5. Within our sectors of energy and transport some R&D is conducted by:

ABB Transport, Derby,

Rolls Royce–NEI: International Research & Development, Newcastle, and amongst the contractors,

AEA Technology, Harwell,

EA Technology, Capenhurst,

PERA, Melton Mowbray.

Responses to the general questions of the sub-committee for GEC ALSTHOM activities:

a. It is not possible to give an accurate breakdown between our applied science/engineering research and product development, but we estimate around 20 per cent of our total R&D expenditure is in the former category and all comments relate to that (hereafter referred to as "science"). Of our approximately £7 million per annum UK spend on science, some 15 per cent (£1 million) is funded from outside the UK, while around £2 million per annum from UK sources funds science elsewhere (predominantly in the EC).

To interpret these figures, it is necessary to understand that our multinational company is organised into product family divisions, each of which is increasingly integrating its existing activities to produce standard products sold across the world. Science is usually funded through a turnover based levy on all the national entities within a division, to which is added national public funding for science (in France through EdF, SNCF etc). The funds are then allocated to those of our international science facilities best positioned to undertake the work, subject to the restrictions on location that are associated with most public funding; particulary from France.

b. In our activities, most science investment, other than that funded internally, is from major state-owned customers. It is an unstated secondary aim of such funding to support the national technology infrastructure to enhance international competitiveness. Most of external science investment originates from France and is thus spent in France even if superior capabilities exist in the UK.

The majority of external science investment to our UK activities is via the European Space Agency and the European Community R&D programmes, where the funding is essentially recycled from the DTI. It is gained by competitive tender with decision based on excellence and cost effectiveness, together with the requirements of juste-retour.

There is negligible private sector funding of our science and a very small amount via other countries' public bodies . Where the latter exists, it is usually because the results will need to be incorporated into a new product for which they have no indigenous supply capability.

c. Benefits to the funder are usually those described above. For our Company, the value is in the reinforcement of our scientific abilities, the opportunity to develop advanced intellectual property and to attract high quality research staff through the activity, the enhanced reputation of the Company through its undertaking the work and the potential thus to attract further investment and the possibility to exploit in other applications the knowledge gained.

d. Expenditure is given in a. above. In all cases, the work undertaken is valued at fully recovered cost, but, frequently, the funding given is deliberately less than this to recognise the potential downstream benefits to us in future equipment manufacture. Between 25 per cent and 100 per cent of full cost is supplied depending on individual customers.

e. Elswhere in the EC, there exist clear mechanisms to support the industrial science base through public sector support. Direct research grants, shared cost developments and enhanced margins in public funding of new technology product demonstrators which include science development. Within the UK, there appears less enthusiasm for such support for industrial science.

Within our industrial sector, there is a tendency for science activity to drift outside the UK and for international investment into the UK to decline. The cause is the relatively lower science support and fewer publicly supported infrastructure developments here, resulting in a gradually declining science base. In consequence, there is a decreasing justification for overseas organisations to invest here.

Mr Douglas Gadd

19 May 1994

Evidence from Glaxo Holdings plc

Introduction

In 1993-94 Glaxo will employ 7,764 people in its world-wide R&D operations and will spend about £860 million on drug discovery and development activities. When capital expenditure of over £280 million is added to this Glaxo's total investment in R&D will be in excess of £1.1 billion. In addition to the R&D activities we carry out in our own laboratories throughout the world we have developed many collaborative arrangements with academic groups and research institutes in the UK, Europe, USA and elsewhere. We regard these collaborations as important because they provide for interactions between industrial and academic scientists, and have the potential to allow for the rapid application of new technologies and exploitation of new knowledge. We have also developed a number of strategic alliances with biotechnology-based companies in order to harness the increasing amount of new knowledge emerging about disease processes and the new technologies in the fields of molecular and cellular biology.

Clearly, as a UK-based multinational company we cannot comment upon issues such as the inward investment in UK science and technology by companies from overseas, but can comment on our position in respect of investment in the UK and overseas. Furthermore, our remarks will arise out of our own experience as a part of the UK pharmaceutical industry, and our views will thus necessarily be of relevance to considerations that apply to that industry.

1. *What is the extent, nature and variety of overseas investment in UK science? How does this compare with investment by UK interests overseas?*

An interesting feature of the world pharmaceutical market-place is that the UK is a small component of it (Table 1), yet the industry last year spent about £1.5 billion on R&D in the UK. Thus it should be appreciated that the amount of investment in R&D in this country is out of proportion to the size of the UK market. Some of the non-UK pharmaceutical companies have chosen to place as much as 25 per cent of their R&D activities in the UK. They, like us, have therefore found this country to provide an environment in which R&D can flourish. There are a number of factors that have encouraged this development which include the quality of British public sector science-base and the skilled scientists and technologists produced by our universities and colleges. Other measures such as the PPRS have in the past also been supportive of innovation in the industry.

Table 1

The World Pharmaceutical Market-Place

Territory	%
NORTH AMERICA	32
SOUTH AMERICA	6
EUROPE	30
UNITED KINGDOM	3
EASTERN EUROPE	4
ASIA AND AUSTRALASIA	8
JAPAN	17

The more detailed reasons for, and extent of, investment in the UK by overseas companies must be sought from the companies themselves, as we are not qualified to provide any more detailed views on this first question.

We are aware of the research initiatives being undertaken by overseas pharmaceutical companies, to develop relationships with UK academic institutions. In particular, we know of the laboratories established by both Eisai and Sandoz within University College London, and Bristol-Myers Squibb's support for the University of Oxford. There are also instances where overseas companies have located research laboratories

in close proximity to universities in order to develop relationships with leading academic groups, e.g. Parke-Davies at Cambridge, and Yamanouchi at Oxford. We do not know any of the details underlying these arrangements but, in our experience, have not yet found them to be of any detriment to our own ability to develop collaborations with these universities. Clearly, care must be taken to avoid the precise fields in which these collaborations are established in order that the university, or department, is not placed in a "conflict of interest" position.

With regard to the second question, although the major part of Glaxo's R&D activities are carried out in the UK, we also have significant R&D facilities in other parts of the world. Our commitment to world-wide R&D is summarised in Table 2. Approximately 30 per cent of our R&D resources are directed towards the creation and discovery of new molecules with therapeutic potential, and 70 per cent is required for those pre-clinical, clinical and regulatory activities which must be undertaken to bring the new molecules to the market-place.

Table 2

NUMBER OF STAFF IN GLAXO R&D FACILITIES WORLDWIDE—1993–94

COUNTRY	RESEARCH	DEVELOPMENT	SERVICES*	TOTAL
UK	773	1,770	1,152	3,695
GIMB (Geneva)	113		27	140
USA	305	928	55	1,288
ITALY	148	270		418
JAPAN	47	208	33	288
FRANCE	60	91	23	174
SPAIN	36	25		61
CANADA	1	103	1	105
OTHER		211	5	216
TOTAL	1,483	3,606	1,296	6,385

*Includes Information Technology

In addition to the staff within our R&D facilities, local operating companies throughout the world employ over 900 medically or scientifically qualified people who support the central R&D activities by organising and monitoring clinical studies with novel molecules within their territories. Although our principal sites for primary manufacture are in the UK we do have significant activities in other areas (eg Singapore). Our secondary manufacturing on the other hand takes place in a number of other countries. Glaxo employs over 430 scientists and technologists in our factories whose role is to transfer the technology developed in the R&D facilities to the manufacturing plants, and carry out further work to develop these new technologies and processes.

As Glaxo is a UK-based multinational company the UK represents approximately 10 per cent of our market place, however, from the data shown it will be seen that approximately 50 per cent of our main R&D activities are now carried on outside the UK. The development of our investment in R&D activities and the changes in their geographical spread over the last 10 years are shown in Table 3. We regard our present situation as stable and it is unlikely, given no unforseen developments, that this pattern of our international R&D investment will change significantly.

Table 3

GROWTH OF GLAXO WORLDWIDE R&D

Total numbers of staff* involved in R&D activities

Country	*1988*	*1993*
UK	2,722	4,150
GIMB	103	140
USA	521	1,440
ITALY	294	418
JAPAN	143	334
FRANCE	121	315
SPAIN	—	106
CANADA	49	185
OTHER	175	491

*Staff in the R&D organisation and staff involved in R&D activities in operating companies

As our R&D activities have expanded, so too has our capital expenditure on new facilities. We have in the last 10 years completed major capital building and equipment projects to establish or enhance our R&D activities in Geneva (GIMB) (£10M), Italy (£68M), Spain (£16M), Japan (£120M) and the USA (£386M). At present we are approaching completion of our major new UK Medicines Research Centre which is being built on a greenfield site at Stevenage, Hertfordshire. This project will have involved a total capital investment of over £750 million by the time it is completed.

Glaxo does make a significant investment in collaborative research overseas. We have major research programmes within universities in the USA, Republic of South Africa, Canada and Australia to which we contribute over £3M per year. In 1989 we initiated collaborations in the fields of molecular and cellular biology in partnership with the Institute for Molecular and Cellular Biology of the National University of Singapore to which we are committing about £20 million over a 15 year period. The purpose of this collaboration is to understand the molecular basis of nerve cell development and regeneration following damage, and also to identify the important molecules which regulate brain function. It is hoped that this will help us to identify targets for treatment of diseases such as Alzheimer's-type Senile Dementias and Schizophrenia and the treatment of post-stroke brain damage. In January 1994 we opened our Centre for Natural Product Research in Singapore which has as its objective the application of biotechnological and other techniques to the screening of materials from natural sources to identify novel molecules with therapeutic potential. This project is sponsored jointly by Glaxo, the Government of Singapore's Economic Development Board and the National University of Singapore, to which the company expects to contribute £13 million over a 10 year period.

Over the last seven years Glaxo has developed a number of strategic alliances with start-up biotechnology companies. The objective of these alliances is to bring together their basic research skills and novel technologies, with Glaxo's abilities to discover and develop new medicines in order to create a synergistic partnership from which both partners will derive benefits and share rewards of success. Thus we are working together to harness their new technologies, or products from their technology, to gain insights into human disease mechanisms, or to define novel targets for creation of new medicines and to develop and evaluate new molecules for their therapeutic potential. Of the 15 strategic alliances that we have at present nine are in the USA, three in Canada, one in Australia, one in Denmark and only one in the UK. This distribution reflects the pattern of commercial development of biotechnology in the world with a preponderance of activity in the USA. The climate in the USA is clearly favourable to this sector and has encouraged scientists in American academic establishments to establish companies, or "research boutiques", to undertake the exploitation of their discoveries. Such a climate does not yet exist in the UK, either within academia or within the financial community. Although recent changes in the London Stock Exchange rules have made investment in start-up companies easier, so far there is only a very small number of such companies quoted compared with the number quoted on the New York Exchange.

2. *What factors influence potential investors in deciding whether to come to the UK for science or to go elsewhere?*

a. Science and technology considerations

It must be recognised that science and technology is now an international activity and there are no boundaries, although different countries will show different levels of commitment and competence and will have relative strengths in different fields of science. As an international company, Glaxo is able to harness the world scientific resource and place its R&D facilities where they will be most effective.

Different considerations apply when we make decisions about the location of our R&D with respect to the drug creation and discovery activities when compared with those involved in drug development. It is however, of overriding importance to us, that in both contexts there are highly-trained scientists, medical practitioners and technologists available in those countries in which we operate. Such people are vital to us, not only to staff our Centres, but also to provide us with scientific and medical collaborators for our drug discovery programmes and the extensive clinical trial programmes we carry out.

Our research activities now require a high level of scientific and technical competence in a wide range of disciplines. We regard it as of paramount importance that we are enabled to carry out research to the highest international standards in our own laboratories. It is essential that Glaxo's research laboratories have within them access not only to the traditional skills base of the industry—inorganic chemistry, pharmacology and biochemistry—but also, increasingly, to the newer areas of cellular biology, molecular biology, structural chemistry and molecular design, and high resolution chemical analysis. It is of growing importance also that we have access to academic scientists working in fields complementary to our own, who should be well equipped to be able to carry out the more basic research which will underpin our own drug discovery programmes. We regard our access to collaborators in academia as vital because our own activities must become increasingly directed towards understanding disease processes and identifying molecular and cellular targets for therapeutic intervention to which we can then direct our drug creation and screening programmes.

For these reasons we regard the provision of high quality scientists and technologists by the educational system, and a strong, well supported and well equipped public-sector science-base, as important aspects of those countries in which we carry out our research activities. We will place our research activities in those countries where we find the scientific strengths we need. Thus at present, our cancer research and research into

the molecular bases of metabolic diseases are carried out in the USA, where there has for many years been a strong emphasis on molecular biology. Most of our pharmacology and biochemistry-based research on the other hand is carried out in our UK and other European laboratories. Particular mention should be made of our major molecular biology facility, the Glaxo Institute of Molecular Biology in Geneva (GIMB). This facility was acquired by Glaxo through the purchase of Biogen Europe in 1987 after we had failed to recruit a sufficient number of well qualified molecular biologists from UK institutions to provide us with the critical mass to enable us to enter the molecular biology field. The scientific and technological staff in Geneva were cosmopolitan when Glaxo acquired the facility and have remained so since then with 24 nationalities represented. We are thus able to attract and keep first-class molecular and cell biologists from many countries including the USA.

The drug development process can be divided into two broad activities: the pre-clinical safety evaluation and formulation work and the clinical trial phases. In the case of the pre-clinical studies these are carried out mainly in our UK laboratories with some studies being performed in Italy and USA. It is most important for this type of highly regulated work to be carried out and controlled within our central facilities as far as possible. In the case of clinical trials, although these too must be carefully controlled, they must be carried out in leading clinical centres where the clinical expertise and the patient numbers are available. As we aim to obtain registration of our new medicines in as many territories world-wide as possible, it has become essential that the proving clinical trials are carried out internationally. Thus in this case, although excellence in clinical science is required in our external collaborators, there are other factors that also come into play when considering the high level of our investment in clinical studies.

In the context of clinical studies with new medicines we would stress the importance of ensuring that the UK does not diminish, or lose, its capability to provide the critical concentration of patients and clinical expertise that is at present provided by our teaching hospitals. Care must be taken to ensure that adequate financial arrangements are available within the new NHS internal market to ensure that these hospitals do not lose the patient base or reduce the facilities which allow them to undertake research as they compete with non-teaching Trust hospitals.

b. *Politico-economic considerations*

The economic and healthcare environments of a country are likely to be factors that companies will take into account when making future decisions regarding the siting of their R&D facilities. An environment which is encouraging of, and rewards, innovation will be preferred to one which is hostile. For UK-based companies, such as Glaxo, the price obtained for its new medicines in the home territory will influence the prices that can be obtained from other governments, and will, of necessity, affect our capacity to contribute towards the positive side of the UK's Balance of Trade. Pricing policies and prescribing practices are thus important in assessing the benefits of carrying out R&D in the UK.

The nature of the process of discovery and development of new medicines means that the pharmaceutical industry has to operate on very long time-scales. The R&D cycle is presently in the order of 15 to 20 years. Our successful performance today is therefore the result of R&D activities undertaken in the past. The medicines that Glaxo has on the market at present must provide the income to fund our R&D to discover and develop the drugs of the future. Therefore government healthcare policies which target the medicines bill, and are driven by short-term considerations can have potentially damaging long-term effects on our activities.

The Pharmaceutical Price Regulation Scheme (PPRS), which has been in force in one form or another since 1957, was introduced by the Department of Health after negotiations with the industry through the ABPI, as a means of regulating the prices paid for medicines by the National Health Service and is renegotiated at intervals. The formula used in the PPRS in establishing the prices that companies charge for their medicines makes allowance for investment in R&D. It was therefore seen to be a measure which was supportive of an industry which was highly dependent on innovative science and technology. Taken by itself the PPRS is more encouraging on innovation than other expenditure control schemes in Europe. However the PPRS is now only one of a number of measures, on the "supply-side", put in place by the Department of Health in order to control its expenditure on medicines. Furthermore it cannot be considered in isolation from other measures, including those on the "demand-side", which have been devised with the introduction of the internal market in the NHS. The danger of considering these schemes in isolation, in so far as they constrain the cost of medicines, is that each may individually be seen as a reasonable request on a profitable industry to "do its bit" in difficult economic circumstances. However, when they are taken together, there is a danger of undermining the industry's ability to be innovative in the long term, and this will risk impairing our ability to contribute to national health and wealth.

Some of the control measures in operation at present are not supportive of R&D leading to innovative new medicines. For example the extended Selected List now contains therapeutic areas such as dermatology affecting more serious conditions and large numbers of people. There is thus now much less incentive for the industry to carry out the necessary research to discover new disease-modifying medicines in these areas. Furthermore there is no longer any benefit to be supporting academic groups working in these fields. Companies will prefer to direct their resources into other fields, or carry out their research and development activities in important Selected List fields in other countries. Supply-side measures, including the PPRS, do not reflect value of medicines to patients because they tend to treat those medicines which are valuable as

equal to those that are less so; thus protecting inefficient treatments whilst restricting the more innovative and efficient ones.

We would suggest that the demand-side measures within the internal NHS market are more likely to be effective in encouraging maximum cost effectiveness, and at the same time achieving improvements in the health of patients. To be successful however this approach must not view the cost of a medicine in isolation from the benefits it can bring, as often happens at present. This approach should be supportive of innovative therapeutic measures which bring improved quality of life and give economic value. Incentive Schemes within the Indicative Prescribing Scheme are a good example of this effect. The incentive is for the GP to prescribe less and so it only takes into account the cost of medicine. Thus the GP who prescribes more medicines, but reduces the need for more expensive treatment involving perhaps surgery and hospitalisation, will receive no reward and may be penalised.

We believe it is desirable that there should be a review of all available mechanisms for the future funding of medicines in the NHS. We believe that such mechanisms should have the capacity to ensure the availability of quality medicines, the continued funds necessary for research into unmet health needs, and the continuing success of the pharmaceutical industry. There is a need to adopt a long-term view in order to reward and so encourage innovation in the industry.

3. *What are the benefits to the parties concerned, and the wider UK economy?*

a. *Benefits for the public-sector science base*

The UK public-sector science base benefits in a number of ways from the pharmaceutical industry. It is difficult to provide any precise figures for the total support given by the industry to academia in the UK. Estimates of between £25 and £35 million have been made.

Glaxo at present provides support for collaborative basic science research projects in 37 universities and other institutions in the UK to which we contribute in excess of £6 million per annum. In addition we may also use academic colleagues to carry out specific pieces of work on a contract research basis—for this we pay about £2 million per annum. We regard academic/industry collaboration of particular importance for our own development because it is only by working together in collaborative partnerships that we will be able to understand the molecular and cellular processes underlying human diseases. It is only by gaining such understanding that we will be able to define new molecular targets for therapeutic intervention. A good example of this relationship is provided by "*action tb*", an initiative that Glaxo has recently established which involves three academic groups in the UK, and four in the Republic of South Africa (via the South African MRC), in addition to our own microbiology research teams. The objective behind this programme is to understand the host defence mechanisms involved in tuberculosis and to unravel the molecular basis of antibiotic resistance now being encountered in TB infections. Thus a successful outcome will enable us to create novel vaccines for the prevention of the disease and new antibiotics for the treatment of resistant forms of the organism. Glaxo has committed a sum of £10 million over the next five years for grants to support this programme, a significant proportion of which will go to the UK collaborating groups.

We see this type of focused research programme as being of increasing importance over the coming years in such areas as human genome research in order to make full use of the new information and insights that will arise from it for exploitation by the industry.

Glaxo also provides support for training of the next generation of research scientists through our support of PhD students. We provide this support in part through the CASE and other Research Council collaborative schemes but we also have an equal number of PhD students who are fully funded by Glaxo studentships. In all we support over 220 PhD students in about 50 UK universities at a cost of approximately £2 million per annum. This provision for training of research students is considerably in excess of our own annual requirements for post-doctoral staff.

The University of Cambridge has benefitted from the establishment of the Glaxo Institute of Applied Pharmacology that was established by Glaxo within the university's Department of Pharmacology. The Institute is staffed by seconded Glaxo staff together with post-doctoral fellows and research students funded by grants made by the company to the University. Our total investment in this Institute over a ten year period is likely to be in the order of £16 million. The Institute serves a valuable purpose in bringing together academic and industrial scientists for drug discovery. This initiative is now being built upon by the creation of a new Glaxo-funded group within the University's Chemistry Department to provide the chemical support for the Institute.

We have established a centre for clinical pharmacology with 24 beds within Northwick Park Hospital in which Glaxo staff and hospital staff can work together on the early clinical studies of new medicines in normal volunteers and patients. We have spent about £2.5 million on establishing this centre in terms of capital expenditure and about £1.5 million per year in staff and running costs for it.

Glaxo has so far also endowed eight Professorial Chairs in UK universities supporting a wide range of scientific and medical disciplines, from medicinal chemistry to molecular parasitology, from cellular pathology to neurobiology, and from clinical pharmacology to bone and joint medicine. These represent a final contribution to the benefiting universities of about £8 million.

Glaxo and other companies within the industry conduct clinical studies of new medicines in leading academic medical departments. Such studies provide an opportunity for UK clinicians and clinical scientists to have access to, and work with, novel molecules that are potential medicines. Furthermore, payments made by us for these studies make a contribution to the income of the collaborating departments, and, through indirect costs, to their universities (see below).

b. Benefits for the wider community

There are obvious benefits which flow from investment in R&D in the UK by Glaxo to a wide range of interests in the UK. For the world community, our R&D activities result in new medicines becoming available that will prevent, cure or alleviate common diseases. These will provide benefits in terms of health of the population, and also for the creation of wealth by enabling people to remain economically productive.

More direct benefits flow to the economy of the UK from the presence of a well-developed pharmaceutical industry here. In terms of provision of jobs in the UK, the industry employed over 76,900 people in 1992 many of whom have scientific, technological or engineering skills or backgrounds. Glaxo employs over 12,000 people in our UK companies which cover activities ranging from R&D, through manufacturing to marketing. UK subsidiaries of foreign-based pharmaceutical companies also employs significant numbers of people in the UK to service their R&D and other activities in this country.

The fact that the UK represents only a small proportion of the world market-place for medicines means that the UK-owned pharmaceutical companies are major export earners: in 1992 the UK industry's exports amounted to £2.993 billion. In the case of Glaxo, 90 per cent of our markets are outside the UK and thus the UK economy benefits directly as a result of our sales overseas. In 1993 these amounted to over £4.4 billion.

4. *What is the level of expenditure by investors and are there costs to the hosts?*

The level of expenditure by Glaxo in support of UK academic science and technology through collaborative scientific research projects and contract research, as outlined above, amounts to over £12 million per year. In addition a further £8 million per annum will be spent with university medical departments in connection with clinical trials.

In the case of research studentships and collaborative research grants there will be a cost to the collaborating department. In the case of our fully funded PhD studentships we pay the student's stipend and university fees and make a significant contribution to the running costs of the research project. The university is expected to provide the infrastructure for the student and his academic supervisor. Glaxo will also provide a member of our scientific staff as an industrial supervisor. Our collaborative research projects usually take the form of post-doctoral fellowships for mission-orientated basic studies. Our normal financial provision includes salary and salary overheads (employer's NI and superannuation contributions) for the personnel supported, funding for the material and other running costs of the programme and a contribution to the indirect costs of the project amounting to 40 per cent of the sum of the above elements. Thus the university is expected to provide the remaining indirect costs of the project and will also provide the services of the member of staff to be responsible for supervising the carrying out of the project. In the case of our research studentships and our collaborative project grants our academic colleagues will have access to those Glaxo facilities which are not available in the academic institution. We believe this to be a fair provision for collaborative work which is in the mutual interest of both the academic supervisor and the company, where the request for support is often initiated by the academic partner, and where there will be a higher level of freedom to publish the results of the work. It is a basis similar to that now used by the Research Councils for their project grants. We regard contract research projects as having a different basis. Usually the company requires a specific piece of work to be carried out for its own purposes, requiring definitive answers, and the academic department has the necessary specialist skills, techniques and equipment. In such cases we would expect to pay the academic department the full costs incurred in carrying out the particular studies. Similarly clinical studies of new chemical entities will be paid for at full costs.

5. *What are the policy implications for the British Government and British science?*

In summary of the above, we believe that the major incentives for pharmaceutical companies to invest in the UK, by conducting R&D in this country, are

i. the availability of well trained scientists and technologists,

ii. a university system that has an infrastructure that makes it capable of engaging with the industry in high quality mission-orientated basic research,

iii. the availability of clinical centres, which are first class by international standards, to undertake early proving clinical studies of new entities, and

iv. pricing policy providing a climate which encourages and rewards innovation.

The policy implication for the British government therefore is to avoid measures that may provide a short-term financial saving but which carry a significant risk of severely damaging or even destroying the UK as a base for pharmaceutical R&D.

Firm steps need to be taken now to ensure that there will be a continuing supply of skilled scientists and technologists in the UK to service the needs of science-based industries. Thus priority must be given to encourage and enhance an enthusiasm for the sciences in pupils from an early age. The teaching of science and technology in UK schools needs to be improved and more young people encouraged to see careers for themselves in science and technology. It is important that the potential of our science and technology students is maximised and that science courses in schools and Further Education Colleges are both relevant and exciting. In the HEI sector attention needs to be given to the contents of degree courses and their structures to ensure that they produce well-trained and practically competent scientists and technologists that meet the needs of wealth-creating industry and commerce. We are particularly concerned at the falling standards of practical laboratory skills that are evident in graduates emerging from UK universities with science degrees. This is due in part, we believe, to the increasing costs of providing practical classes but is also due to the time pressure imposed by the increasing range of the science syllabus. Serious consideration will need to be given to the length of first degree courses in the sciences, an issue that may be made more serious if the level reached by A level students leaves a serious gap between the knowledge base needed for the present degree courses.

Particular emphasis should be given to provision of training for technologists for industry and public sector laboratories; a group who, in the context of the pharmaceutical industry, are disappearing in some parts of the country. The trend towards taking degree courses in science is leading to this route being taken by individuals who in times past would have developed their careers as laboratory technicians. We are therefore losing people who would have made good technicians and gaining instead science graduates lacking practical skills. Thus we would suggest that more should be done to improve the status of technologists, encourage careers in technology, and perhaps then provide technology degrees, or equivalent qualifications, with a strong emphasis on practical skills to meet this need.

There needs to be investment in the infrastructure of UK universities in order that they may be in a position to both teach science and technology and carry out scientific research to highest standards to match our competitors. We are very concerned at the deterioration that has been allowed to happen in respect of the infrastructure of many UK academic science departments. The result is that state-of-the-art facilities are often not available within our universities, either for high quality research or for training, or that academic researchers are working in less than ideal conditions. We accept however that, in considering the renewal of the research infrastructure of the public sector science base, decisions will have to be made to concentrate the available resources and develop centres of excellence.

Further measures are required to encourage collaborations. These need to be between university departments and also between academic institutions in order to provide interdisciplinary approaches to basic problems in strategic fields in order to provide underpinning basic science for UK industry. Further steps to encourage academic/industry collaborations should be given a priority in the plans of the new Research Councils who, we suggest, should devote a significant part of their resources to developing and managing focused research in areas of importance to the health and wealth of the UK. Other issues which create barriers to collaboration also need to be resolved, one of which is the ownership, handling and exploitation of intellectual property arising out of collaborative programmes. The work started in this field by the SERC could be built on with advantage.

Strong centres of clinical research in those countries in which pharmaceutical companies operate are essential for the clinical development and evaluation of novel medicines. Thus, as has been pointed out above, it is essential that the government takes steps to ensure that within the environment of the NHS internal market the UK's major centres of clinical research can survive and flourish and will not be put in jeopardy and to encourage their development by the provision of state-of-the-art clinical resources to maintain their world-class standards.

Finally, with regard to medicines pricing and prescribing policies, the point made above should be emphasised. Such policies should not be viewed in isolation from each other and in particular care should be taken to ensure that their effects, either separately or cumulatively, do not inhibit or stifle innovation by the R&D-based pharmaceutical industry or create an environment that is hostile or discouraging of investment in the UK and its public sector science base.

29 April 1994

Letter from Heochst UK Ltd

Thank you for your invitation to contribute to your Sub-Committee I enquiring on International Investment in UK Science. I answer your questions as follows:

1. Hoechst UK Ltd currently employs together with its sister company Roussel Laboratories Ltd (to be combined in a joint venture 1.7.94) in the UK over 200 people in pharmaceutical and clinical research. Through a joint venture Hoechst/Schering AgrEvo the company employs some 600 UK staff in crop protection research and development. The group employs either directly in HUK or subsidiary companies such as AH. Cox Ltd (pharmaceuticals), RV Chemicals Ltd, HPG (paints) or Harlow Chemicals (resins) a further some 200 staff in research or development work.

2. Hoechst first became significantly involved in UK science in 1968 when the Berger Jenson Nicholson paint group was acquired, with its own considerable research organisation (200 staff). Subsequent significant

increases in involvement included the establishment in 1973 of a pharmaceutical research centre at Milton Keynes (at peak 250 staff), the expansion of our veterinary research effort on the same site, the expansion of the R & D effort at Harlow and in 1985 the acquisition of AH Cox Ltd in Barnstaple. The single most significant steps since have been the JV with Schering Agrochemicals and the proposed JV with Roussel Laboratories.

3. The company has long established contacts to UK universities especially in the field of life sciences e.g. Surrey, Open, as well as research institutes eg Dunedin which have often led to the successful development of significant new products, eg new pasteurella vaccine. A list of current academic contacts is appended (*not printed*).

4. Hoechst is a German based company with the bulk of its research effort in Germany (58 per cent) but conducts R & D in 16 countries of which the most important are Europe excluding Germany 21 per cent, US (16 per cent), Japan (4 per cent).

5. All the major pharmaceutical companies have UK R & D activities and the importance of this will increase with the establishment of the headquarters of the European Medicines Commission in London. Additionally all the major chemical and biotechnology companies should be contacted both those UK based and those non UK based.

6. To our mind the overriding message for the Science and Technology Committee is that industry needs to put its case to ensure that the Government encourages an economic and business scenario that will ensure that companies continue to invest in R & D in the UK, as well as inward investment for other assets. This has been one of the major planks of our discussions with the Department of Health over the Price Regulation Scheme. The pharmaceutical sector of the industry has always argued that it must have a stable economic background and an understanding by Government of the needs of industries that have very long term R & D horizons.

Dr. W. McDowell

1 May 1994

Evidence from Kobe Steel's European Research Laboratory

Why the UK?

Kobe Steel established a European research laboratory as part of its strategy of globalisation and diversification.

It located its European research laboratory in the UK because of

(1) the high reputation of the UK science base in materials science generally, and the composite materials more specifically. There was some debate whether Germany would have been a better choice because of a perception that Germany had a better technological base.

(2) the advantage of easier communication in an English speaking country.

(3) the Japanese perception of a generally welcoming attitude by UK government and other institutions and individuals to Japanese investment and people—France and Germany seemed more reluctant and less welcoming.

Personal relationships in business are very important to the Japanese. The company had gradually built up relationships with British institutions and universities over a period of some years. For example Kobe Steel has a close relationship with St. Catherine's College, Oxford, and the President of Kobe Steel is an honorary fellow of that college; it had funded work at several British universities for two to three years before founding the Laboratory; and it had formed a good relationship with many senior British scientists through a senior Kobe Steel scientist resident in Britain (Dr. Shigeko Suzuki). The value of these personal relationships should not be underestimated.

Why Europe?

There were several reasons for Kobe Steel establishing a laboratory in Europe.

(1) As a precursor to the more active development of business, including manufacturing.

(2) To access more easily European science and technology.

(3) To bring a multi-cultural approach to its corporate research. There are very real differences in the way Japanese and British approach research.

(4) Because of a concern that the increasing demand for scientists and engineers in Japan would lead to a shortage of very able researchers there.

Kobe Steel—Its business and research

Kobe Steel Ltd is a large diversified Japanese industrial corporation. In addition to being one of Japan's leading steel makers, it is a major domestic supplier of aluminium and copper products, industrial and construction machinery, and plant engineering services. The Company is also building new businesses in high technology areas such as electronics, advanced materials, information systems, factory automation and robotics.

In 1992 Kobe Steel Ltd employed more than 20,000 people and registered total sales of 1,177 billion yen (approximately £7.2 billion) made up of iron and steel 43 per cent, aluminium and copper 21 per cent, welding materials 4 per cent and machinery 32 per cent. Its total R&D expenditure is approximately 3.5 per cent of sales.

Kobe Steel Ltd is the parent company of the Kobe Steel Group, which includes more than 50 overseas subsidiaries and affiliates in the Americas, Europe and Asia as well as numerous companies in Japan.

As part of its strategy of increasing globalisation and diversification Kobe Steel established three overseas research laboratories between 1988 and 1990, one in Europe and two in the USA. They form an integral part of Kobe Steel's corporate research activity and their principal function is to support specific technical areas of new business development.

The European Research Laboratory

The European research laboratory is situated on the research park of the University of Surrey at Guildford. It was founded in the autumn of 1988 and became operational in autumn 1990 when its new building, which had been under construction, was commissioned. It employs approximately 30 people carrying out R&D on polymers, composites and diamond thin films in programmes which are integrated and co-ordinated with activities at Kobe Steel's large new corporate research laboratories at Kobe and in the other overseas laboratories. Formally the European research laboratory forms part of Kobe Steel Europe Ltd, which is a company registered in the UK and wholly owned by the parent company Kobe Steel Ltd.

The research into polymers and composites is supporting the development of a globally situated new business in high performance reinforced plastics. These materials are being increasingly substituted for steel and aluminium. The research into diamond is targeted principally at electronic applications.

Professor D C Phillips

Technical Director

16 February 1994

Supplementary evidence from Lilly Research Centre Ltd

In my evidence to the Select Committee on Wednesday 23 March 1994 I indicated that Eli Lilly and Company would provide detailed information on their operations in the United Kingdom at a later date. I hope to provide the required information in this letter.

I have taken the opportunity to use the questions asked by the Select Committee during this enquiry:

Q1. *What is the scale and nature of your research operation in the United Kingdom?*

A. All pharmaceutical research in Eli Lilly and Company is conducted within one world-wide division, Lilly Research Laboratories with the major facility in Indianapolis, Indiana, US and other facilities in the UK, Germany, Belgium and Spain in Europe with some research in Canada and Japan. The operation in the UK is approximately 10 per cent of our research commitment and has a direct reporting relationship to Lilly Research Laboratories management in the US.

Total UK staff in research is approximately 300 of whom one third hold a first level degree and one third a higher (PhD) or a medical degree. The Lilly Research Centre at Windlesham, Surrey occupies approximately 150,000 square feet of laboratory and office accommodation and is administered financially through Lilly Industries Limited, a holding company within which are Dista Products based at Speke in Liverpool and our marketing and sales organisations based in Basingstoke in Hampshire.

Q2. *What is the history of your parent company's involvement with UK science?*

A Our initial involvement with UK Science was through the National Research Development Corporation in the mid-60s where we licensed, on a non-exclusive basis the rights to develop cephalosporin science. Lilly were particularly successful and much benefit derived to NRDC and its successor organisation, the British Technology Group, as well as Eli Lilly and Company. Since the opening of the Lilly Research Centre at Windlesham in 1967 the majority of our subsequent involvement has been through this site.

Q3. *What relations do you have with UK academic science?*

A We have extensive links with British universities ranging from consultancies, through studentships at undergraduate level (industrial years), postgraduate studentships and support of postdoctoral fellowships.

Specifically we have endowed a chair at the University of London (St. Bartholomew's Hospital Medical School), two senior lecturer posts at Christie Hospital in the University of Manchester, the Lilly Diabetes Research Laboratory at Birmingham University and have provided support to the Cancer Research Campaign and the Imperial Cancer Research Fund over many years.

We sponsor a number of awards and prizes within the academic community. These include a bi-annual prize in clinical pharmacology under the auspices of the British Pharmacological Society, the Lilly Prize for Pharmaceutical Excellence under the auspices of the Royal Pharmaceutical Society of Great Britain, science prizes in diabetes and psychiatry in addition to sponsorship of annual lectures at the Royal College of Physicians, the Royal College of Physicians of Edinburgh and the Royal College of Psychiatrists. Pre-clinical and clinical travel awards are made to enable young research workers to attend international scientific meetings and this includes a formal MRC Travelling Fellowship Programme.

In the medical arena we were responsible for establishing the Eli Lilly National Audit Centre at the University of Leicester, which is currently being used by the Department of Health. We have participated in three SERC/DTI LINK schemes and in the MRC Collaborative Awards Programme.

Finally a number of our staff participate in Research Council review bodies, notably SERC and now within BBSRC and EPSRC. We take great pride in participation in the infrastructure of UK academic science.

Supplemental Question: In your letter to Dr Kipling (ABPI) on 28 March 1994, you noted that the Sub Committee would be interested to know whether, as reported, we were reducing our R&D operation at Windlesham.

In December 1993 Eli Lilly and Company instituted a voluntary redundancy programme throughout the world. As a result some 2,600 Lilly employees decided to accept this package, about 10 per cent of the total work-force world-wide. Lilly Industries UK, including the Research Centre, employ some 2,300 staff and some 220 of these accepted the package in the UK. There were no special factors which would single out the United Kingdom from other parts of Lilly world-wide operations and this reduction in staff occurred in common with many other companies within the pharmaceutical arena also reducing staff. The proportion of staff involved at the Research Centre was similar to that at the other sites in the UK. This is a direct reflection of the more hostile environment in which companies do business at the present time. In addition, the down turn in the animal science arena has caused a further reduction in our staff at Dista Products in Speke which, again as part of our corporate philosophy, was managed as a voluntary redundancy programme.

I am grateful to Dr G B Coutts, Medical Director, Lilly Industries Limited for help in preparing the data above.

I hope that the information complements that which I presented to the Committee. If I can be of further help please let me know.

Professor William Dawson

Director, Technology Acquisition

2 June 1994

Evidence from Matra Marconi Space

(1) Introduction

Matra Marconi Space was asked to answer the following specific questions relating to international investment in UK science.

(i) What is the scale and nature of your research operation in the UK?

(ii) What is the history of your parent company's involvement with UK science?

(iii) What relations do you have with UK academic science (ie, the universities and research councils)?

(iv) If your company conducts R&D in other countries too, where and why?

(v) What other international R&D operations in the UK would you advise the Committee to contact in order to get a full pictue of such activity in your sector?

Each of these questions is addressed in turn in paragraphs 3 to 7 below. Paragraph 2 contains a short introduction to the origins and operations of Matra Marconi Space, which may help in providing contextual background for our specific answers. Paragraph 8 gives general comments relating to the Committee's investigations.

(2) MATRA MARCONI SPACE

Matra Marconi Space is a joint venture company which provides complete space systems and their individual elements (satellites, payloads, ground terminal, equipments, components) to a broad range of national and international government, agency, and commercial customers. It was formed in 1990 by merging the space business assets of its two parents, the UK company GEC-Marconi, and the French company Matra Defence-Espace, part of the Lagardère group. Matra Defence-Espace holds 51 per cent of Matra Marconi Space, while GEC-Marconi holds 49 per cent.

The company is legally structured as a holding company, Matra Marconi Space NV, registered in Holland, with two principal subsidiaries, Matra Marconi Space UK (to which all the UK staff belong) and Matra Marconi Space France, which holds the employment contracts for all French staff. The company is, however, managed as an integrated entity, with an Anglo-French headquarters team based in the Paris region, five business units (which in three cases include both French and UK operational elements), and separate UK and French operations directorates which provide supporting products and services.

Although decisions on R&D investment are made by the Business Unit and Operations Directors for the benefit of the company as a whole (subject to coordination by headquarters management through a budgetary process which is subject to parent company approval), the specific R&D actions are subsequently accounted to either one or the other of the principal subsidiaries, depending generally on the country in which the work is carried out. Note, too, that we have rationalized our R&D activities since the company was formed to avoid duplication of effort; this process was facilitated by the generally complementary nature of the constituent companies' space activities.

(3) *What is the scale and nature of your research operation in the UK?*

Matra Marconi Space carries out applied research and development in the UK aimed principally at producing equipments and payloads for communications and microwave remote sensing satellites, and communications satellite fixed and mobile Earth terminals; we carry out studies of future systems in order to foresee satellite and payload requirements, and undertake research and development on a smaller scale in satellite propulsion systems and other platform equipments, in composite products for non space applications, and in satellite remote sensing image and data processing systems. For some applications, where the commercial return is distant or unlikely (Earth observation and science instruments and satellites, for example), development costs are largely payed by the (government or Agency) customer, often after "seeding" by the company to establish and demonstrate a key competence; for telecommunications satellite and ground terminal applications, where there is a more mature commercial business, development is more usually company-funded, although some customers are prepared to pay some of the development costs for very specific applications.

Because of the nature of our business, which is only now beginning to move from a situation where it is unusual to make more than two examples of any spacecraft, there is little separation between development and production activities. Consequently, we do not have a separate R&D department; development is done by engineers who may at other times be supporting "production" activities.

In 1993 the total expenditure by Matra Marconi Space on R&D (including customer-funded R&D) was MECU 66; the Matra Marconi Space UK total R&D expenditure was £25 million.

(4) *What is the history of your parent company's involvement with UK Science?*

Our UK parent, GEC-Marconi, is part of the GEC group which with its constituents (which include GEC itself, AEI, the Marconi Company, and Elliot Brothers) has had a close relationship with many aspects of UK science, dating back to the beginning of the century. Our French parent, the Lagardère group, is a French company which includes hi-tech (Matra), media (Hachette) and banking (Arjil) interests. To my knowledge, it had minimal interaction with UK science before the formation of Matra Marconi Space.

(5) *What relations do you have with UK academic science (ie the universities and the Research Councils)?*

(a) Research Councils

(i) The Astronomy and Particle Physics Research Council (APPRC) is a co-funder, through its budgetary support to the ESA science programme, of the European scientific satellites to which Matra Marconi Space contributes hardware elements (eg the propulsion subsystem and instrument payload for the current SOHO spacecraft). APPRC also funds the instruments developed at Universities and the Rutherford Appleton Laboratory which may, as in the case of SOHO, be integrated by Matra Marconi Space onto their parent spacecraft.

(ii) The Natural Environment Research Council (NERC) has recently taken responsibility for all Earth Observation science (formerly partly within the SERC brief). Consequently, NERC is now a potential customer for Matra Marconi Space equipment and services.

(iii) The Engineering and Physical Sciences Research Council (EPSRC) funds academic research into spacecraft engineering, and Matra Marconi Space is often consulted concerning the relevance of proposed research to industrial applications.

(iv) Matra Marconi Space is represented on Research Council and British National Space Centre (BNSC) Boards (such as the BNSC Earth Observation Programme Board) where UK space policy is reviewed and discussed.

(b) Universities

Matra Marconi Space has close relations with many UK Universities which are active in space research and related engineering topics, especially those located near the principal Matra Marconi Space UK sites in Portsmouth and north-west London; interactions are summarised in the attached table.

Matra Marconi Space Relationships with UK Higher Education Institutes

Institute	*Faculty or Department*	*Nature of Interaction*
University of Portsmouth	Engineering	Co-sponsor of GEC-Marconi Chair of Systems Engineering (terminated in 1993). System engineering research. Materials Assessment. Student Projects.
	Physics	Support to Microwave Physics M.Sc Course*
University of Surrey	Engineering	Representation on Steering Committee of Centre for Satellite Engineering Research. Lectures on short courses
University of Southampton	Aeronautics and Astronautics	Funded research on the space environment (outgassing)
	Engineering	Co-operative research on medical implants
Queen Mary and Westfield College, University of London	Aeronautics	Representation on Steering Committee
University of Leicester	Engineering	Co-operative research on automatic control for space applications
Bolton Institute	Engineering	Co-operative research on smart structures
Royal Liverpool University	Clinical Engineering	Co-operative research on medical implants

*including lectures, steering committee representation, and student industrial placement.

(6) *If your company conducts R&D in other countries too, where and why?*

(i) Matra Marconi Space carries out R&D in France as well as the UK, as explained in (2) above.

(ii) Matra Marconi Space wholly owns a small subsidiary in Australia, Auspace Ltd, which carries out research and development in support of Australian space programme and defence needs.

(iii) Matra Marconi Space has part-ownership of subsidiary companies in Spain, Italy and Belgium which carry out development in support of European space programmes.

(7) *What other international R&D operations in the UK would you advise the Committee to contact in order to get a full picture of such activity in your sector?*

Although Matra Marconi Space is the only integrated multi-national space company in Europe, other UK space companies carry out R&D funded by European and other customers. The principal UK companies active in space system research and development are:

—British Aerospace (Space Systems) Ltd.

—Logica Space and Defence

—Vega

—Earth Observation Systems

—National Remote Sensing Centre Ltd.

—Satellites International

—Dowty Aerospace

—Royal Ordnance

—Cray.

The University of Surrey "spin-off" company, Surrey Satellite Technology, has been particularly successful in obtaining overseas orders for its micro satellites.

(8) MATRA MARCONI SPACE RESPONSES TO THE GENERAL QUESTIONS WHICH THE COMMITTEE SEEKS TO ANSWER.

This paragraph contains some general comments related to the scope of the enquiry, grouped under the headings of the questions which the Committee seeks to answer.

(a) What is the extent, nature, and variety of overseas investment in UK science?

As explained in paragraph (2) above, Matra Marconi Space as a multinational company decides on its research and development activity in each space business sector where the headquarters of that business unit is located, but the research carried out in a particular country will generally be accounted to the subsidiary based in that country. Some interesting, but minor, exceptions occur as a result of the technological rationalisation within the company: for example, the Matra Marconi Space centre of excellence for space control system development is in France, but a relationship is being established with the control group at the University of Leicester who have an international reputation in advanced control methods which appear to offer very significant improvements for future Matra Marconi Space products.

(b) What factors influence potential investors in deciding whether to come to the UK for science, or to go elsewhere?

The factors would be, in order of importance:

—quality of the science

—cost–effectiveness of proposed work

—accessibility, including language, electronic communication and ease of physical access.

In cases where funding is undirected (eg, support of a chair) the choice of institution would still be driven by proven scientific track record.

(c) What are the benefits to the parties concerned, and the wider UK economy?

To the UK science group, there is clearly an opportunity to preserve or expand their centre of expertise, and to become better known outside the UK (and so in consequence attract more funding of new opportunities for collaborative research). For the investor, the principal benefits relate to the factors which influence investment decisions; cost-effective access to world-class scientific research.

(d) What is the level of expenditure by investors, and are there costs (direct, indirect or intangible) to the hosts?

The overall level of expenditure by investors is a matter for the Sub-Committee to assess. Costs to the hosts could include a restriction on intellectual property rights, but this would generally be a matter for case-by-case negotiation.

(e) What are the policy implications for the British Government and British science?

British Government policy, as expressed in the White Paper "Realising Our Potential", is that science and engineering research should form part of the UK's "wealth producing chain"; this policy is expressed in the mission statements of five out of the six newly-created Research Councils, which require each of them to place "special emphasis on meeting the needs of users of its research and training output, thereby enhancing the United Kingdom's industrial competitiveness and quality of life". It is clear that this mission would be unlikely to be fulfilled if the majority of British science were directed by overseas investors. Consequently, the benefits to British science from overseas investment noted in (c) above must be weighed against the effects on the UK economy as a whole, and an appropriate repartition achieved.

The steps taken by government (such as setting up the Technology Foresight programme) to encourage interaction between UK science and UK industry are welcomed as part of a process to maintain this balance.

Letter from Merck Sharp & Dohme

I am writing in response to your letter of 31 March, with some comments on the abovementioned topic.

MSD Limited, part of the multinational Merck & Co. Inc, has a substantial investment in research in the UK. Our annual operating budget is approximately £30 million and, in the past decade, the company has a total capital investment in UK R&D facilities of some £50 million. We employ 250, mainly British, scientists in our research establishments, the largest of which is the Neuroscience Research Centre in Harlow, which is devoted to the discovery of new medicines to treat mental and neurological illnesses. The Harlow laboratory is a new venture, opened in 1984. Support of the UK science base consists of:

1. Grant support for university collaborative projects, usually "blue sky" in nature, with a total budget of £250,000 per annum;
2. Contribution to two Link schemes, £25,000 per annum;
3. Support of jointly sponsored PhD students in British universities, a total of 25 students each year;

4. Training of undergraduates from British universities as part of "sandwich" courses, a total of 15 students each year.

We located major research facilities in the UK because of the perceived high quality of the science base. We are concerned by the erosion of the UK science base, both in terms of its size and its quality, in the past decade. We continue to benefit from exposure to academic science in Britain, and Britain benefits from financial support and employment of scientists by our company. Merck & Co. has an annual R&D budget in excess of $1 billion and operates research laboratories in the USA, Canada, France, Italy, Spain and Japan.

I hope these comments are of some help to you.

Leslie L. Iversen, MA, PhD, FRS

Director

12 April 1994

Letter from Nissan Motors (GB) Ltd

May I begin by apologising for the delay in replying to your enquiry.

The answers you require are as follows:

(1) Nissan confines its major programmes to Japan as it is the company's policy to use its overseas engineering centres, such as the European Centre at Cranfield, to get its engineers closer to the individual markets and customers. The work of these engineers is therefore necessarily design and development rather than pure research.

(2) Our parent company has no direct involvement in UK science. The small number of projects in progress with UK universities have been instigated by Nissan's long established technical centre in Brussels.

(3) Nissan's priority is design and development. In a submission to the House of Commons Science and Technology select committee we explained that we believe the emphasis is wrong in the UK. Nations such as Germany have built great success upon the ability to improve things rather than invent new ideas. Improved steel is of more use to the industry than a new "blue sky" technology.

You will not be surprised to learn that Nissan's link with universities is based around the need to improve the standard of engineering graduates and help to prepare them better for industry. The company has worked closely with Hertfordshire, Newcastle, Sunderland and Durham universities with engineers and executives forming valuable links with individual departments.

Nissan does have a small number of research projects in progress including a materials project at Imperial College.

(4) We work with a wide range of motor industry research, development and testing companies in the UK where British industry has an established expertise. The companies include: Motor Industry Research Association, SDRC, IAD, Masco Tech and Hawtal Whiting. In addition we constantly work to encourage our suppliers to develop their own design and development capability as we believe this is essential in the long term.

I hope this provides an outline of our activities and highlights the importance that we place on development rather than pure science. We will, of course, be happy to contribute to the work of the committee further if this would be of assistance.

Daniel Ward

Director Corporate Affairs

27 April 1994

Letter from Pfizer Ltd

Your letter dated 4 February to Mr O'Connor has been redirected to me for a response. I offer the following comments to your questions:

1. *What is the scale and nature of your research operation in the UK?*

All pharmaceutical research in Pfizer is grouped into one worldwide division, Central Research, which operates out of four main centres in the US, UK, France and Japan. The operation in the UK is the centre for our European Operation and is directly responsible to the President of Central Research in our headquarters function in Groton, Connecticut, US.

The Sandwich organisation is the second largest of the Pfizer Central Research centres and, outside the USA, is the largest research centre of any US pharmaceutical company. It comprises all the scientific

disciplines and supporting functions required to undertake the discovery and development of new medicines from the initial idea stage through to world-wide registration.

Total UK staff in Research is currently 1,250, of whom 34 per cent hold a first level degree and 31 per cent a higher (PhD) or a medical degree.

In 1989 we initiated a substantial expansion of our research accommodation from 300,000 square feet to give now a total of about 800,000 square feet of offices and laboratories.

2. *What is the history of your parent company's involvement with UK science?*

Any involvement has been almost entirely through Central Research in the UK.

3. *What relations do you have with UK academic science?*

We have links with about 25 British Universities and our annual budget for pre-clinical grants and consultancies is currently more than £1.5 million per annum. This does not include any of our clinical grants.

In the science area, the types of funding include consultancies with senior academic staff, collaborative research projects, contract research work, post-doctoral fellowships and a chair at the University of Kent. We make six Pfizer Academic Awards annually, each of £6,000, to assist young University scientists in their research. We also award travel grants to permit young academic staff to attend international scientific meetings. Other additional payments include support of conferences, goodwill grants to university departments and prizes for posters and scientific communications. We participate in the SERC CASE studentship scheme, in the SERC/DTI LINK scheme and in the MRC Collaborative Awards Scheme. We also have an extensive programme to support and encourage the teaching of science in both primary and secondary schools.

In the clinical area, we have a number of consultancies with clinical staff in hospital and university departments. We also fund research agreements with specific university and hospital clinical departments for work related to our research interests. In some cases, a registrar post is funded as part of the agreement. We also have a travel grant scheme designed to enable young clinical research workers to attend meetings to present scientific and clinical papers.

4. *What other international R&D operations in the UK might be contacted?*

I suggest that the major international R&D organisations which would be worth contacting are SKB, Roche and Merck.

5. *The Financial Times Report*

I confirm the comments reported in the FT of 13 December 1993 and have nothing further to add except to append a recent report from Scrip dated 15 February 1994, which reinforces many of the points (*not printed*).

Peter S Ringrose MA PhD

Senior Vice-President Medicinal Research and Development Europe

24 February 1994

Supplementary letter from Pfizer Ltd

Following our meeting with Sub-Committee 1 of the Select Committee on Science and Technology, you asked if we might provide a fuller answer to Question 1 on the prepared list—"Where do you do your R&D and why?" I covered this to some extent in my letter dated 24 February 1994 and am pleased to provide the following amplification.

The manufacturing plant, established in the UK in 1954 was the first plant which Pfizer built outside the US. It represented a major step for a company which had hitherto been a purely US domestic organisation and it is significant that the UK was chosen as the site to supply Europe. Three years later, as manufacturing became established, a small research organisation was formed. One of the reasons for this was that the excellent reputation of British science was familiar to the US Pfizer management especially through their association with the development of penicillin fermentation during the war.

The availability of good scientists made growth of the embryo organisation possible and some early successes ensured its continuing existence. In 1967, the Pfizer research organisations in the US and UK were reorganised with a view to closer collaboration. In the ensuing division of research targets, it was decided that all the Company's cardiovascular research, now one of the most important areas for Pfizer, should be concentrated in the UK. The reason for this was primarily the excellence of the schools of pharmacology in this country with their production of scientists trained in complex animal work. Such pharmacologists were not widely available in the US where research into cardiovascular drugs was hampered by the lack of people to establish effective biological testing systems.

Since the early 70s, the UK R&D group has been increasingly successful and three of the most recent major drugs (Diflucan, Istin and Cardura) launched by Pfizer were discovered in our UK laboratories. Obviously a major factor in this has been the excellence of the scientists whom we have been able to recruit. Nearly all our staff and all our senior management are recruited in the UK (although some have undertaken post doctoral research in the US and other parts of Europe). In the past ten years, Pfizer has more than doubled its total research effort. This growth has been shared equally between the US and the UK and a good supply of well qualified staff has been crucial for the expansion in the UK.

Other factors have also contributed to the success (and continued existence) of the UK research operation. The excellent medical infrastructure with its specialist hospital groups has made it relatively easy to undertake high quality clinical studies and many clinicians with international reputations are available as consultants and advisers. The UK medical schools are accepted as amongst the finest in the world and clinical work undertaken in the UK is accepted everywhere. The medical climate in the UK has always been favourable to research and, in the past, there has been little trouble in finding collaborators for various research projects. Whether this is going to continue to be the case, in the straitened circumstances of the Health Service, remains to be seen and we are now tending to place an increasing number of studies in Europe.

Another factor which helps our clinical research is the enlightened regulatory approach in the UK. Approval for clinical studies through the CTX system is based on a system of negative vetting of a summary of scientific data. This process normally takes 35 days which is considerably more rapid than the systems obtaining in many other countries, particularly the US.

As mentioned above, we are now tending to place more work in Europe. One reason is that the countries of the EU are developing better science infrastructures and therefore presenting more opportunities for collaborative work. Another point is that the great expansion in the amount of work, especially clinical trials, which we now have to undertake through external investigators is making it necessary for us to make increasing use of European facilities.

Another question raised during the committee session was whether constraints on profits received through sales to the NHS were, for companies manufacturing OTC drugs, compensated for in part by profits on sales of such preparations. In case of Pfizer, OTC sales contribute to the profits only to a very limited extent in some parts of the world. OTC medicines represent a small proportion of our total sales and an even smaller share of our profits.

I trust that the above information will be of interest to the Committee.

Peter S. Ringrose M.A. PhD.

Senior Vice President (Medicinal Research and Development, Europe)

10 May 1994

Evidence from Philips Electronics

Q1. *What is the scale and nature of your research operation in the UK?*

Philips Research Laboratories at Redhill, Surrey have been one of the main research centres for the worldwide Philips Group for nearly 50 years. They concentrate on applied research and are currently world leaders in development of multimedia, software, liquid crystal display technology, large area electronics and cordless communications. Numbers employed are 250, including 170 professional engineers. In addition, there are 100 people on advanced development work at Philips UK manufacturing sites.

Q2. *What is the history of your parent Company's involvement with UK Science?*

As mentioned in Q1, Philips has had a major Research Laboratory in the UK at Redhill, Surrey for approaching half a century, and major technical and manufacturing establishments in Scotland, the north east and north west, Cambridge, south of London and on the south coast. We operate in the electronics field, with interest in Electronics, Engineering, Physics, Chemistry, IT, Mathematics and Technology.

When surveyed a few years ago *all* of these centres had some ongoing contact with Academic Science (see answer to Q3 below).

In addition to these activities many sites have a long history of active involvement with Government supported collaborative R&D programmes: DSIR, ACTP, CVD, SERC, Teaching Company Scheme, ALVEY, LINK, EUREKA.

Many, but by no means all, of these programmes were, in the past, related to defence programmes. Twenty years ago 25 per cent of our Research Laboratory was working on Government supported programmes. This has now fallen to a small percentage.

Q3. *What relations do you have with UK Academic Science?*

At any one time there are many contracts of various types between our UK establishments and UK academic science.

In a detailed survey a few years ago we registered 211 active technical contacts with 61 Universities and Polytechnics. The majority of our contacts were with the faculties of Electrical/Electronic Engineering, Physics, Chemistry and Mathematics.

The nature of our technical contacts is broad. It includes joint working to the mutual benefit of both parties with no monetary interchange, sponsored research studentships, sponsored research, joint involvement in Government initiated research programmes, paid consultancy, donation of advanced technical equipment (eg Molecular Beam Epitaxy equipment), etc.

We contract several Universities to carry out research. The contract sizes vary from £12,000 to £200,000. Currently we have projects with Surrey, Imperial College, RCA, Cambridge, Oxford, Liverpool, Dundee, Queen Mary Westfield.

We also contribute, primarily via our Research Laboratories, to the educational provision within UK Universities by giving invited lectures and having at any one time some 6–8 of our staff operating within the Higher Education Sector as Visiting Lecturers, Readers and Professors.

We also give guidance to the management of half a dozen Universities by membership of their Advisory Boards.

Q4. *If your company conducts R&D in other countries too, where and why?*

Philips has a Corporate Research organisation with Laboratories in Holland, the UK, Germany, France and the USA. Operating in this manner enables us to share talents and resources, and benefit from the diverse viewpoints of several cultures. It also gives us windows into a number of key markets, and contact with important parts of the international scientific world.

Product development, however, is organised differently. This function is strongly linked to our internationally organised Product Divisional structure which also is responsible for production.

Q5. *What other international R&D operations in the UK would you advise the Committee to contact in order to get a full picture of such activity in your sector?*

(This question is too broad for us to answer effectively.)

Q1. *What is the extent, nature and variety of overseas investment in UK science? How does this compare with investments by UK interests in science overseas?*

(We do not have relevant information.)

Q2. *What factors influence potential investors in deciding whether to come to the UK for science, or to go elsewhere? (whether elsewhere in the EC, or elsewhere in the world.)*

We see the main factors as:

—The availability of trained and skilled people

—Academic strengths in relevant fields in the UK

—The rapid take-up of innovative products in the UK market

—The availability of financial support from the Government

—The English language—especially in the growing areas of multimedia

Q3. *What are the benefits to the parties concerned, and the wider UK economy? (both short and long term, both tangible and intangible—including such matters as training, employment, intellectual property, access to and exploitation of results, one form of investment attracting another)*

The benefits to the investors are largely covered by the answer to Q2.

The UK benefits from such inward investment by enhancing the scientific and technical skill base, generating intellectual property rights, helping stimulate local manufacture and employment and the associated supplier/support/service infrastructure.

Such activity also stimulates training, creates relevant technical knowledge to provide that training and feeds back into the knowledge base in UK academic establishments.

These benefits come about most effectively where there is a technical/technological skill base which is able to exploit the scientific activity.

Q5. *What are the policy implications for the British government and British science?*

It is important that foreign companies investigating scientific activities in the UK feel they are operating on a level playing field with no bias between GB and EEC firms, no presumption in favour of (ex) Government R&D activities, no favouritism shown to small or large firms. It is perhaps worth recognising that it is large companies who are most able to invest in the UK—or anywhere else.

It is therefore vital that to attract such activity against foreign competition we must ensure the supply of high quality scientific and technical talent, maintain or enhance our technical infrastructure and service base, and stimulate those of our industries which supply and support such activity.

Lastly the greatest stimulation which UK science and technology can have is to feel wanted: wanted by the pull of an active, growing, hungry manufacturing base, by an alert public which sees the relationship to wealth creation, and by a government which shows positive interest and encouragement.

Evidence from Rhône-Poulenc

1. Rhone-Poulenc is a multi-national Chemicals Group with headquarters in France. The Company has major R&D Production and Marketing activities in the UK with an annual UK turnover of £757 million.

Rhone-Poulenc in the UK is divided into three companies which reflect the Rhone-Poulenc Group's businesses, these are: Rhone-Poulenc Chemicals Limited, Rhone-Poulenc Agriculture Limited and Rhone-Poulenc Rorer (Pharmaceuticals). Each of these Companies undertakes R&D for its own area of business. The R&D is situated at the following locations:

Pharmaceuticals—Dagenham, Essex.

Agriculture—Ongar, Essex.

Chemicals—Avonmouth, Clayton (Manchester), and Leeds.

The R&D undertaken at these Centres is an allocated UK part of the overall international Rhone-Poulenc R&D and is generally aimed at the discovery and development of products for the international markets. Some of the effort is devoted to developing products for the UK home market. Total annual R&D expenditure in the UK by Rhone-Poulenc is £40 million.

2. Rhone-Poulenc's involvement in UK science reflects the history of the Company back to the 1930s or even earlier. The UK Pharmaceutical and Agricultural parts of Rhone-Poulenc, previously May and Baker until the name was changed to Rhone-Poulenc in 1988, developed substantially after the second World War with subsequent expansion over the following decades. The Chemicals R&D arose from RTZ Chemicals which was acquired by Rhone-Poulenc in 1989 and has a past history in the compenent companies from which RTZ Chemicals was formed.

3. Rhone-Poulenc has very strong links with UK academic science. The Company's Research Laboratories have close links with university academics in the appropriate fields of science, through consultancies and research projects supported at the universities. There is a close inter-action between the Company and the University scientists which is very important to the success of the Company's research.

Rhone-Poulenc also has a general strategic interest in UK university science and has a policy of seeking and supporting new areas of science emerging from the science base which might be of interest to the Rhone-Poulenc Group in the longer term. The Company supports a number of projects of this nature with the aim of taking the science forward to a stage where its direct commercial application can be considered. Use is made of Government schemes available for joint University/Industry projects eg CASE Awards and LINK Schemes and these provide a very useful source of funding for research which is too speculative and at too early a stage to justify full sponsorship by the Company.

4. Rhone-Poulenc undertakes the greatest proportion of its R&D in France and as well as in the UK, has major Research Centres in the United States. This reflects the origin and development of Rhone-Poulenc. The strength of the science bases in these countries is very important to the Company's Research establishments.

Evidence from Rhone-Poulenc Agriculture Limited (RPAL)

The research activities of RPAL are an integral part of the research effort of the French parent company, Rhone-Poulenc Agrochimie. Internationally the research activities are based on three major Research Centres which are specialised in their areas of expertise. These Centres are:

La Dargoire, Lyon, France—specialising in fungicides and process chemistry/Physicochemical properties for all agrochemicals.

Research Triangle Park, North Carolina, USA—specialising in insecticides and studies required specifically for registration in the USA.

Ongar Research Centre—specialising in herbicides and the environmental impact of all agrochemicals.

Research is also carried out at Tsukube Akeno, Japan (products for Japan and the Asiatic area) and Sophia Antipolis, France (toxicology, ecotoxicology and animal metabolism). In addition, research is supported by research farms situated around the globe (including one at Manningtree in Essex which is linked to Ongar).

The co-ordination of the global research effort is carried out by the R&D Director of Rhone-Poulenc Agrochimie based in Lyon.

Ongar Research Centre is a major centre for Rhone-Poulenc Agrochimie, previously being involved in all types of agrochemical research but from 1988 specialising in the discovery of new herbicides and the environmental impact of agrochemicals. At this time two other major centres also became specialised in their areas of expertise.

Currently the R&D team at Ongar comprises approximately 180 people of who 50 per cent are graduates (25 per cent Ph.D level). The main disciplines covered are biology, biochemistry and chemistry, support is given by agronomists, information scientists and computer specialists. For the research team within RPAL the work is centred in the UK, however, the discovery of herbicides inevitably means that co-operative studies are carried out in areas with crops which cannot be grown in the UK, eg rice in Asia.

RPAL has numerous links with academics and supports a vigorous programme of collaborative research at a number of centres. Currently work is sponsored in eight UK universities which is focused on key problems related to our R&D mission.

The collaborative studies may be at post-doctoral or studentship level and are either fully sponsored by RPAL or with eg the BBSRC. The "former AFRC" institutes are recognised as important scientific resources and programmes have been carried out at the Institute of Arable Crops Research at Long Ashton and the John Innes Institute at Norwich. In addition several of the research staff at RPAL have a scientific profile external to the Company, being active in publishing, symposia, committees etc.

Evidence from Roche Products Ltd

1. *What is the scale and nature of your research operation in the UK?*

The Research Centre in the UK is one of the four main International R&D Centres of the Pharmaceutical Division of the Swiss company Roche Holdings. There are approximately 400 R&D staff employed in the UK with about 320 being employed in non-clinical R&D and 80 in clinical R&D. Discovery Research employs about 180 people in the UK concentrated on two therapeutic areas—Virology and Inflammation/Autoimmune Disease. Other therapeutic areas such as Oncology and Cardiovascular Diseases are handled by other Roche R&D Centres. All the Scientific disciplines which are necessary for the discovery and development of new medicines are represented in the Welwyn R&D Centre. These include: medicinal chemistry, computer aided drug design, molecular biology, biochemistry, pharmacology, toxicology, pharmacy, statistics, medicine and regulatory affairs.

2. *What is the history of your parent company's involvement with UK science?*

The R&D Centre in Welwyn was founded in 1937 when the UK company moved out of London. This was the first R&D Centre outside of Switzerland which was established by Roche. There were major expansions of the UK R&D Centre in the early 1970s and again in the early 1980s. Since the beginning of this decade there has also been steady growth and the 1994 headcount is 25 per cent higher than the 1990 headcount.

3. *What relations do you have with UK academic science (ie, the Universities and the Research Councils)?*

We have considerable contacts with UK academia ranging from funding of PhDs through the SERC and MRC collaborative schemes through to funding of post-doctoral fellows and a professorship. We have participated in several LINK projects jointly with other industrial concerns and we also regularly interact in a less formal manner with many UK scientists who are working in the same fields as ourselves. This has led to many papers jointly published by scientists from Roche and UK academia.

4. *If your company conducts R&D in other countries too, where and why?*

The headquarters of Roche is in Switzerland and one of the largest R&D Centres is located there. Because of the importance of the USA and Japan in the world pharmaceutical market Roche also has major R&D Centres located in these countries. Several small Centres, mainly involved in clinical research, are located in various countries to organise clinical trials locally.

5. *What other international R&D operations in the UK would you advise the committee to contact?*

Most of the major international pharmaceutical companies have some R&D efforts in the UK, eg Merck, Pfizer, Wyeth, Bayer, Ciba, Sandoz, Hoechst, Lilly. More recently the major Japanese pharmaceutical companies have also started research centres in the UK eg, Yamanouchi and Eisai and it may be worthwhile contacting them. The ABPI should be able to give you a complete list.

Evidence from Rolls-Royce plc

2. *What factors influence potential investors in deciding whether to come to the UK for science, or go elsewhere?*

The most important factor is probably the quality of our academic research, as evidenced in publications and in international conferences, where UK contributions continue to be well above average. To some extent we may also be trading on the long established reputation of our older universities, but the diligence of some of the newer ones in attracting overseas students must be beneficial in raising their profile as potential contractors for research.

Another factor is the low cost rate for any research activity in the UK, compared with most of our major competitors.

3. *What are the benefits to the parties concerned, and the wider UK economy?*

For the UK to be successful as a manufacturing nation, it must have a strong technology base. This will be enhanced by overseas investment in the UK universities.

Whilst the IPR resulting from specific programmes will be the property of the investing company, the background knowledge and many of the people involved in the programmes will remain in the UK and be available to UK industry.

These two benefits lead us to favour investment from overseas. However, we do have some concerns about the potential leakage of knowledge of our methods and products from university centres with which we have established close ties, and set up programmes under conditions of particular commercial trust. Although the integrity of our academic collaborators is not in doubt, the presence of overseas students (sometimes even from the companies of potential competitors) in their departments has given cause for concern as to the security of our own technology base. Thus, the naturally more open environment of a university may ultimately limit the scope of joint activities, but security-locked "enclaves" are a possible solution.

The loss of IPR to the funder of the programme is of lesser concern. Universities tend to over-value IPR, because they do not fully appreciate the costs associated with taking the results of the research to the market place.

5. *What are the policy implications for the British government and British science?*

The UK government investment in UK universities and manufacturing industry should match that of the other major manufacturing nations. Overseas investment is not a solution to lack of UK government investment in its own infrastructure. It is, however, a way of gearing up a basically sound UK strategy for investment in research.

One possible model is for the infrastructure, including all Basic Research, to be funded through the HEFC. All Applied Research would then be funded jointly by the Research Councils and UK Industry, or by overseas investors at premium rates reflecting their benefit from the infrastructure.

Ideally, UK companies should have the same opportunity to invest in overseas universities.

Evidence from Sharp Laboratories of Europe Ltd

I was pleased that the Sub-Committee visited us on 9 March. It was a good opportunity to show that the investment by Sharp Corporation in research and development at Oxford is one of the most important and substantial investments of its type currently in the United Kingdom.

I have attached to this letter, as an annexe, the information which I sent to the Sub-Committee previously concerning the establishment and activities of our Laboratories. I should like to make some further comments which may be of help to the Sub-Committee about the advantages to the United Kingdom and to the Science Base of investments of our type.

The United Kingdom has an enviable reputation for the strength of its Science Base in spite of difficult funding conditions over the last 10 or 20 years. In a large part this has been due to the sustained high quality of both the training and research output of United Kingdom researchers over a long period.

As we know, in some sectors there has been excellent research which has not led to matching industrial exploitation to the benefit of the United Kingdom as a whole. We can analyse and in some cases deplore the reasons for this, but the current UK position in electronics and computers is a case in point. The strength of highly competitive American, Japanese, German and French companies has led to a relative decline in these sectors by purely United Kingdom owned companies. (I am not forgetting the excellent market positions which some United Kingdom companies have in these fields. But these are relatively narrow and do not appear to compensate for the overwhelming manufacturing position of foreign companies supplying consumers and businesses with electronics and computer products.)

The attraction of the United Kingdom as a manufacturing base for foreign-owned companies has been an important antidote to this. As is well known, the United Kingdom is now a net exporter of home-produced consumer electronic products such as televisions. In addition, the investment by the Japanese in companies such as ICL and Honda has strongly fortified these concerns to enable them to not only survive but compete

globally. It follows, therefore, that we should encourage as far as possible further investment into the United Kingdom by the Japanese, Americans, Europeans and others. There are a range of advantages which the United Kingdom offers such investors and amongst these are the skills and infrastructure of our Science Base.

Investment by foreign-owned companies (and in some cases semi-official organisations) in the United Kingdom Science Base has, I believe, many benefits and very little disbenefit. The benefits include employment of researchers with objectives closely in line with wealth-making activities on a global scale. Secondly, direct investments from foreign-owned research and development activities into the United Kingdom Science Base is an increasingly important factor for universities. The presence of organisations like ours representing strong manufacturing interests will be as important in helping to re-focus university research and wealth-making as are the benefits which the UK industrial workforce gains from companies who have brought advanced manufacturing know-how to the UK.

I would reject a view that there could be a net loss to the United Kingdom and its Science Base through transfer of know-how to Japan and other countries by inward investment in R&D. Our operations are focused on carrying out research in our own facilities in the United Kingdom with European staff to achieve the best possible result in terms of exploitable know-how. Where we can find the right opportunity we will form links with universities and other organisations. For example, our presence in the United Kingdom can greatly facilitate links which embryonic hi-tech firms in the UK can have with a potential major international customer.

I should like to summarise by saying that investments such as ours and other Japanese companies are of benefit to the wider UK Science Base and therefore I believe that the Sub-Committee should give consideration to a recommendation to Government for further actions to encourage such inward investment. I understand that in a number of universities there are already units aimed at encouraging links with inward investors. I believe such activities should be expanded.

Dr C C Bradley

Managing Director

31 March 1994

SHARP LABORATORIES OF EUROPE LTD

Sharp Laboratories of Europe Ltd was established in 1990, firstly in Abingdon, Oxfordshire, and presently on the Oxford Science Park, Oxford. SLE is owned by Sharp Electronics (UK) Ltd (80 per cent), Sharp Manufacturing France (5 per cent), Sharp Electonics Espana (5 per cent) and Sharp Electronics Europe GmbH (10 per cent). These companies are owned in turn by Sharp Corporation registered in Osaka, Japan.

Benefits of European Location for Research Laboratories

- Complementary research skills and scientific culture
- Vertical integration into the European market
- Easier access to European R&D and technology
- Lower costs
- Avoidance of trade friction
- Image building

Mission for SLE

Our role is to:

- generate creative technical ideas and provide Sharp Corporation with new and advanced technologies for future products.
- undertake state of the art research programmes in fields which are important to Sharp Corporation.
- establish a role at the centre of Sharp's innovation activities in Europe.
- be accepted as part of the scientific community in Europe.
- contribute to increasing knowledge of advanced science and technology for the benefit of everyone.

Choice of Location in the United Kingdom

The United Kingdom was chosen by Sharp for the site of its first overseas R&D laboratory for two main reasons. Firstly, English is the most familiar foreign language to Japanese engineers and scientists and is the language of science and technology and secondly, the UK enjoys a high reputation for the standard of basic research and research training in higher education.

The Oxford Science Park has the advantage of proximity to a large university with many departments doing world class research in fields of interest to Sharp. Also there is a relatively high density of research organisations and high technology companies in the Oxford area and several other universities are situated not so far away. Oxford is a good location for attracting high quality staff.

Funding

The costs of establishing Sharp Laboratories of Europe in a purpose-built building on leased land on the Oxford Science Park were met from the capital provided by the shareholders (£9·9 million). Research costs on an annual basis are mainly obtained through a single contract with Corporate R&D Group in Sharp Corporation in Japan. There are minor contracts with other divisions of Sharp Corporation including Sharp Manufacturing (UK) and a small amount of funding is obtained through a co-operative project with the Department of Trade and Industry.

Research Fields

- Imaging Technology
- Optoelectronics
- Information Technology
- Liquid Crystals

We have installed advanced laboratories for semiconductor and liquid crystal research including a clean room.

Human Resources

In the first phase which has been completed, the number of staff has reached 47. This includes 36 staff directly involved in research and 11 others involved in administration, strategy and planning and liaison. In the case of the research staff, 29 out of 36 have PhDs. Staff were recruited about equally from industry and universities with a small number from Government organisations. The average age of the research staff is 33. There are three secondees from Sharp Corporation currently working in SLE, two in administration and one in research. The staff also include five non-UK European nationals.

There are plans in principle for an increase in staff to around 100 when the second phase of building on the Science Park is approved and executed, possibly in 1996–67.

Co-operation

Our objective is to conduct a research activity in a similar way to domestically owned organisations in the UK and Europe. Therefore we have endeavoured to support research in universities and to participate in DTI and EC research programmes.

UK Joint projects with Universities (100 per cent funded by SLE)
Support of research student (CASE and other)
DTI/SERC project
DTI project

EC ESPRIT (Basic Science)
Expert Groups
COST

Future

We aim to develop further co-operation with universities in Europe and to substantiate the responsibilities which SLE has for Sharp Corporation's innovation activities in Europe. We also aim to develop co-operative ventures with UK and European based companies. Our overall objective is to develop in-house a wide range of new ideas which can be patented and provide a basis for new Sharp products in the future.

25 February 1994

Letter from Siemens plc

I acknowledge receipt of your inquiry of 8 April 1994. I am more than happy to answer the questions that you have put forward.

1. Last year Siemens in the UK spent a total of £127 million, that is 10 per cent of our turnover, on R&D here in the UK. The emphasis is on D rather than R. When it comes to research very little is being carried out here at Siemens in the UK. Here we rely mainly on our central research facilities in Germany and the States. R&D covers a wide range of different products and systems. Enclosed you will find a copy of a transparency (*not printed*) that gives you an idea of the scope being covered here in the UK. Apart from R&D activity

closely associated with our manufacturing facilities here in the UK, we own a development centre, "Roke Manor", which was initially part of Plessey. This R&D centre carries out contract R&D for Siemens in the UK and Siemens world-wide.

2. As you may be aware, Siemens has a long history here in the UK. After the second world war Siemens started to build up R&D and manufacturing activities which now employ 5,000 employees, roughly fifty per cent of our total staff.

3. Traditionally we have been in close contact with a number of UK universities. The relationships keep changing, depending on the expertise and what we are looking for. To give you two examples, we have had corporate agreements with the universities of Edinburgh in the area of medical engineering, and with Brunel in the area of CAD.

4. Siemens is a global player and consequently conducts R&D in many countries around the world, the reasons vary. We have extensive R&D activities in the States, in order to be close to the developments there. However, the majority of our R&D work is carried out in Germany, this has mainly historical reasons. When it comes to research we rely to a large extent on universities around the world.

5. Regarding question number 5, I suggest that you contact IBM and Hewlett Packard.

I hope that these answers will help to enlighten the issue.

Jürgen C. Gehrels

Chief Executive

20 April 1994

Evidence from Toshiba Cambridge Research Centre Ltd

Question 1: *"What is the scale and nature of your research operation in the UK?"*

Answer 1: Toshiba Cambridge Research Centre Limited (TCRC) started its operation in January 1991. The current staff number is 13 including 7 research staff, who are headed by Professor Michael Pepper, the Company's Managing Director, who is concurrently Professor of Physics at Cavendish Laboratory in the University of Cambridge. The Company's research area is the physics of advanced semiconductor structures and in more detail focuses on exploring new quantum physics of electron transport in semiconductor structures controlled at atomic level. The issued capital is £600,000 and currently the scientific research operation is conducted with a budget of approximately £1.6 million per annum. At the moment, all the research funding is provided by Toshiba Corporation in Japan. The Company's office and laboratory is located in the Cambridge Science Park, where it has leased premises of approximately 9,600 square feet of floor space. One of the most important research activities of the Company is the collaborative research project established with the University of Cambridge and funding is provided by TCRC to the University for this purpose. TCRC is also supporting an Assistant Director of Research position and other staff positions in the Cavendish Laboratory.

Q2. *"What is the history of your parent company's involvement with UK science?"*

A2. As a result of discussions in the early 1980s between the then President of Toshiba Corporation, Mr Shoichi Saba, (Hon) KBE, and the then British Ambassador to Japan, Sir Hugh Cortazzi, Toshiba commenced the Toshiba Fellowship Programme Scheme, fully funded by Toshiba, whereby one-two post-doctoral scientists of British nationality spend a period of up to two years working in Toshiba's Research and Development Laboratories in Japan mainly located in, but not limited to, Kawasaki, Japan. The Scheme was inaugurated in 1983 and applications have been invited annually since then. 13 researchers were awarded the Toshiba Fellowship in its 11-year history and currently the 10th, 11th and 12th year programmes are in operation. The majority of Fellows returned to the UK, after having completed the Scheme in Toshiba Japan, to take up positions within academic/government organisations, including universities, DRA Malvern and BT Research Lab. A Committee, whose members are nominated by SERC (now Engineering and Physical Sciences Research Council) and Toshiba, interviews applicants and, following the Committee's recommendation, Toshiba offers the appointment. Additionally, the Corporate Research and Development Laboratories had a research and technology representative in London whose knowledge of UK science was a significant factor in the establishment of TCRC.

Q3. *"What relations do you have with UK academic science (ie the universities and the Research Councils)?"*

A3. The TCRC supports research students through the CASE scheme at three British universities, ie Cambridge, Oxford and Nottingham University. An extensive research collaboration exists with Cambridge University in projects which also receive funding from the Engineering and Physical Sciences Research Council. The most attractive feature of UK science which lends itself to the collaborative research with a multi-national corporation is the strength of the basic, curiosity oriented, research and its associated infrastructure, as well as the freedom and flexibility of institutions in developing contacts and making collaborative research agreements.

Q4. *"If your company conducts R & D in other countries too, where and why?"*

A4. Toshiba Corporation has no other independent research laboratory outside Japan. TCRC is Toshiba's first corporate level research laboratory, conducting fundamental research, established outside Japan, although development and design activities directly linked to manufacturing are conducted in various factories throughout the world including factories in the UK as well as the European Union and the United States of America.

Q5. *"What other international R & D operations in the UK would you advise the Committee to contact in order to get a full picture of such activity in your sector?"*

A5. In so far as laboratories established by Japanese electronic companies are concerned, I suggest that you contact Sharp Laboratories of Europe Limited located in Oxford Science Park.

Dr Yasuo Ikawa

Deputy Managing Director

11 May 1994

OTHER

Letter from the Chemical Industries Association

I refer to my letter of 24th February, in which I made some general comments as a preliminary input to the above enquiry on behalf of CIA. In my letter I pointed out that the CIA Science, Education and Technology Committee (SETCOM) would meet to discuss the enquiry on 9th March, to see if there were any further points to be made on behalf of the Association, in addition to the responses of individual Member companies.

As a result of our meeting I would like to make the following observations which I hope you will find useful. Essentially, they address *question 5* in your call for evidence; "What are the policy implications for British government and British science?"

The tables below outline the sources of funding for chemistry within higher education institutions, excluding the former polytechnics. The figures are the most recent available to us. These data demonstrate that, for the central discipline of chemistry, the overseas component of total research support has increased dramatically. Although the support from the Research Councils has increased in cash terms over the period shown, this has not kept pace with increased investment from UK industry or from overseas sources. In short, it appears that support for chemistry is becoming increasingly dependent upon external funding, and that the largest increases are from international sources. This general trend is not confined to chemistry: a similar pattern emerges for biological sciences, including biochemistry, and for science as a whole.

(Chemistry) Total Funds (£M)

Source of Funds	*1985/86*	*1991/92*	*% Change*
Research Councils	16.5	18.2	+10
Central Govt.	3.9	3.9	—
UK Ind. & Comm.	5.5	8.3	+51
Overseas	2.2	5.0	+127
Other	3.3	6.4	+94
Total	31.4	41.8	+33

(Chemistry) % of Total Funds

Source of Funds	*1985/86*	*1991/92*	*% Change*
Research Councils	52	43	−17
Central Govt.	12	9	−25
UK Ind. & Comm.	17	21	+24
Overseas	7	13	+86
Other	12	14	+17

Source: Science & Engineering Research Council (approximate figures).
All data based on 1991/92 constant prices, using a GDP deflator.

The fact that there has been an increase in the level of international investment in the UK science base, is not in itself a bad thing. Indeed, it would be worrying if investment from industry, from the UK and overseas, had declined, since we regard our science base as one of the UK's more attractive business assets, and certainly worth investing in. What does concern us is that this external investment has not been matched by government.

Increased overseas investment in UK science raises another, more worrying issue: to what extent is the UK science base becoming an asset for our major competitors? While we would not support a protectionist attitude towards scientific research, government should be aware of the fact that our competitors are free to exploit Europe's science base for their own domestic industrial development. Japan, in particular, has identified basic scientific expertise as a weakness of its chemical industry. The Japanese have therefore increased their investment in UK and European research, in terms of people and funds, for export back to Japan. UK and European government should respond to this in two ways:

- ensure that the climate for innovation, ie. science base exploitation, is at least as favourable here as it is elsewhere, with the establishment of a legal and regulatory framework which encourages research and technological development, and
- seek to ensure that the science bases of our competitiors are as open and available to us, as ours is to them. At present, at least for Japan, this is not the case, since European companies are not eligible to participate in Japan's government-sponsored R&D programmes, while Japanese companies benefit from such programmes in Europe.

In summary, we welcome increased investment in the UK science base, whatever the source. However, there needs to be a similar commitment to investment by government, and there should be equal opportunities to access and exploit scientific and technical expertise on a global basis.

On behalf of the Association, I would like to thank you for seeking our comments on this issue.

Dr P A Leonard

20 April 1994

Evidence from Alex Crawford, Editor of Laboratory News

SUMMARY

1. Recent increases in international investment in UK science mask the dangers associated with the relative weakening of the overall level of investment in UK science in comparison with that in the science of the UK's international competitors.

2. It would be highly appropriate for the UK Government to introduce real incentives for overseas firms to invest in UK science.

3. It would be appropriate for the UK Government to introduce tax credits for firms to invest in UK science, with special consideration being given to the level of tax credits for overseas firms starting to invest in UK science.

4. In setting its provisions for total net Government expenditure on S&T, the UK government should take into account the adverse impact on the confidence of potential overseas investors of reduced Government expenditure in UK S&T.

5. To be successful in attracting overseas investors to set up major international R&D facilities in the UK, the Government needs to play a pro-active role in order to co-ordinate an integrated approach, plan for the long term, and invest for the future.

6. In conducting the Technology Foresight Programme, the Office of Science and Technology should be encouraged to come forward with proposals that will attract international investment in UK science rather than confine its work to how it can help the UK Government and industry to make better informed decisions.

7. Only if the UK Government effectively tackles the issue of attracting an increasing proportion of young people into science, will it be able to promote the UK to potential international investors in science.

1. *Overseas investment in UK science*

The extent of overseas investment in UK science was indicated in *Forward Look 1994* (Ref. 1), which showed the overseas percentage of investment in business enterprise R&D increasing from 7 per cent in 1983 to 16 per cent in 1991 and showed it falling back again to 15 per cent in 1992.

However, while the total UK investment in UK science has been declining in real terms, the total investment in science in many of the UK's competitors was increasing in real terms.

The increase in the overseas percentage of total investment in UK science could be interpreted as indicating the attraction of the UK for investment in science because of the strength of UK science. But, it could also be seen as a consequence of the decline in the UK's own investment in UK science, as a result of which overseas competitors moved in to take advantage of available scientifically trained personnel and make use of facilities that are not being used by UK Government and industry.

This is consistent with the view of the recent Hosue of Commons Select Committee Report (Ref. 2):

> "International comparisons show that UK companies are, on average, significantly less profitable than their competitors, and also that their rate of investment, both in capital equipment and in the development of new products, is less.[219] This is consistent with the loss of market share suffered by many sections of UK industry since the 1960s, but there appears to be no single explanation for this poor performance, rather it appears to be due to a complex of interacting factors, both external and internal to the company."

2. *Overseas investment in total*

The Government's recent *Competitiveness* White Paper compared overseas investment in the UK with UK investment overseas (Ref. 3).

This showed that foreign companies invested £115 billion in the UK in 1991.

Forward Look 1994 showed that overseas investment in UK business R&D was £1.24 billion in 1991, so overseas investment in UK science comprised only 1.1 per cent of total overseas investment in the UK. In other words, overseas investment in UK science is a smaller proportion of total overseas investment in the UK than is UK investment in UK science as a proportion of total UK investment in the UK. This means that overseas companies have seen the UK as more appropriate for investments in down-stream activities than for investments in science.

This interpretation is borne out by the absence of any reference to UK science from the inset in the *Competitiveness* White Paper giving some of the key strengths of the UK according to recent investors (Ref. 4):

- High labour quality and flexibility
- Low overall costs
- Low total labour costs
- Deregulated business environment
- Superior international air services and efficient low cost road transport
- Competitive telecommunications
- Market proximity
- Financial incentives
- Low corporate and personal tax rates
- The English language and ease of communication
- The warmth of welcome and attitude of Government and investment promotion agencies.

This interpretation is also borne out by the minimal reference to science in the inset on inward investment in Scotland, Wales and Northern Ireland. (Ref. 5).

3. *Spillover at the country level*

The recent House of Commons Select Committee report examined the extent to which R&D expenditure has increased productivity (Ref. 6). It indicated that a country, such as the UK, stands to benefit even more from investment in science by overseas firms than those firms do themselves.

It would, therefore, be highly appropriate for the UK Government to introduce real incentives for overseas firms to invest in UK science.

4. *Fiscal incentives*

The House of Commons Select Committee report also took into account the new evidence collected by Bronwyn Hall on the effectiveness of the United States' system of tax credits for additional R&D expenditure (Ref. 7). She suggested that, in the 1980s US firms spent an additional $2 billion-a-year on R&D over and above the $1 billion-a-year that the US Government lost in tax credits.

After further investigation and consultation with a number of economists, the House of Commons Select Committee therefore recommended (Ref. 8): "... a major re-examination of the case for fiscal incentives for investment in research and development, both at personal and at company level. Such a review should be conducted openly, and its conclusions should be considered by experts outside the Treasury."

This recommendation reinforces that of the House of Lords Science & Technology Committee in 1991 (which the Government subsequently rejected) that a company should be given a tax credit for the amount of real additional expenditure on R&D which a company makes over the previous year's total (Ref. 9). This could be particularly helpful where a company is proposing to start investing in UK science.

It also corresponds to the view in *Laboratory News* in 1989 (Ref. 10): "If the Government sees the UK's future in R&D-based industries, then the only way forward is for it to re-equip publicly-funded laboratories now and to give incentives to companies to invest in industrial R&D in adverse economic circumstances."

It would, therefore, be appropriate for the UK Government to introduce tax credits for firms to invest in UK science, with special consideration being given to the level of tax credits for overseas firms starting to invest in UK science.

5. *UK investment in UK science*

One of the weaknesses in the proposition that the increase in the overseas percentage of total investment in UK science indicates the strength of UK science is that both the UK Government and UK industry are decreasing their expenditures in UK science.

Forward Look 1994 report (Ref. 11): "The total net Government expenditure (including VAT) on S&T in 1994–95 is planned to be £6,106.5 million (including the indicative contribution to the EC), with £3,568.7 million to be spent on civil S&T and £2,537.8 million for defence S&T. The total is planned to decrease to £5,993.6 million in 1996–97 (a decline in real terms of 7.7 per cent); civil S&T (including the indicative contribution to the EC) is planned to decrease by 2.3 per cent in real terms over this period whilst defence S&T decreases by 15.2 per cent."

Forward Look 1994 also reported (Ref. 12) that, despite repeated Government exhortations aimed at motivating UK industry to increase its spending on R&D, there was a decline in real terms of 10 per cent between 1989 and 1992.

In setting its provisions for total net Government expenditure on S&T, the Government should take into account the adverse impact on the confidence of potential overseas investors.

6. *Personnel available for employment in UK science*

Another weakness in the proposition that overseas investment is attracted by the strength of UK science is the decline in personnel employed in UK science. For example, the most shocking statistics in *Forward Look 1994* concerned the total number of personnel engaged in industrial R&D in the UK. They showed a cut-back from 188,000 in 1986 to 142,000 in 1992—a drop of 23 per cent. The number of industrial researchers fell by 18 per cent in that period (to 71,000) and the number of technicians slumped by over 30 per cent (to 34,000).

These severe cut-backs in industrial R&D personnel, combined with the decline in the UK Government's own investment in R&D, bode ill for the future employment prospects of the increasing number of graduate scientists, engineers and technologists that are due to come onto the labour market.

Forward Look 1994 heralded a 70 per cent increase in the number of such graduates by 1996, when compared with 1989 (See Figures 2 and 3, Appendix).

7. *Promoting investment in UK science*

The attention of the House of Lords Select Committee on Science and Technology Sub-Committee II has already been drawn to the essential rôle that the UK Government needs to play if the UK is to attract major science facilities, for which it is competing against governments which effectively co-ordinate national, regional and local support for inward investment (Ref. 13).

For example, there is a proposal, provided for in the Rushmoor Local Plan Review (Ref. 14), for a science park to be located at Farnborough Aerodrome once the Ministry of Defence disposes of it as surplus to its requirements in 1996. In relation to this proposal, the evidence submitted to Sub-Committee II stated (Ref. 13):

> "... the MOD and the DRA at Farnborough need to have, as an objective of policy, to compensate for declining defence work by increasing the overall level of civil employment by, for example, ... the DRA becoming involved as a partner in Farnborough International Science Park (FISP) on part of the 820-acre site that it is releasing. The FISP would build upon the high-technology image of the area, which is associated around the world with the Farnborough International Air Show. However, it would be important not only to attract aerospace and defence firms to the FISP but also to attract other high-technology industries of the future (such as biotechnology, communications, environmental technology, and others that may be identified in the Office of Science and Technology's Technology Foresight exercise). It would also be appropriate to promote the FISP to attract headquarters and laboratories for multinational companies, and UK Government and European Union institutions.
>
> "The strategy of developing the Farnborough Airfield site by bringing together the DRA, British Aerospace (which has its headquarters there at present), the FISP, the NSC (National Science Centre), and the proposed University of North Hampshire would be to act as an engine of economic growth not only for the local area but for the region. The opportunities for cross-fertilisation of ideas and experiences would be encouraged within such a very positive framework, as the whole culture of the local community would be oriented towards SET (science, engineering and technology).
>
> "This is a true diversification strategy, as it implies a widening of the employment base without abandoning defence work. However, its success depends on the Government playing a pro-active rôle in co-ordinating an integrated approach, planning for the long term, and investing for the future—all crucial elements which seem absent from current policy."

8. *Factors influencing potential investors*

To understand the factors influencing potential investors in deciding whether to come to the UK for science or to go elsewhere, it is important to appreciate that companies will generally take these decisions in relation to their overall competitive strategies, as explained by Michael Porter in his 1980 *Competitive strategy* (Ref. 15).

Although the recent *Competitiveness* White Paper contained new initiatives to promote inward investment (Ref. 16), none sought to increase investment in UK science and none took into account the strong competition afforded by the governments of competitor nations (such as the United States, Italy and France) for international investment in science.

Michael Porter set out the sources of, and impediments to, global competitive advantage, which potential international investors in UK science would take into account in deciding whether to come to the UK for science or to go elsewhere—and which the UK Government, development agencies, and regional and local authorities should be seeking to optimise for the UK economy (Ref. 17):

"*Comparative Advantage.* The existence of comparative advantage is a classic determinant of global competition. When a country or countries have significant advantages in factor cost or factor quality used in producing a product, these countries will be the sites of production and exports will flow to other parts of the world. In such industries, the strategic position of the global firm in those countries possessing a comparative advantage is crucial to its world position."

In the *Competitiveness* White Paper, the UK Government gave some examples of UK sectors which it saw as world class (pharmaceuticals, biotechnology, and aeronautics), but it also recognised the need for improvement (Ref. 18). However, it did not bring forward any practical initiatives aimed at giving potential international investors in UK science comparative advantages in global competition that would encourage them first, to invest in UK science, and, as a consequence, to site production in the UK. It confined itself to exhorting UK companies to become more innovative and to outlining how it assisted UK companies to improve their innovative performance.

The *Competitiveness* White Paper outlined how the Technology Foresight Programme will help to identify opportunities by examining both market developments and technological capabilities within the UK over the next two decades (Ref. 19). However, again, the aim of the Technology Foresight Programme is to enable UK Government and industry to make better informed decisions, rather than to attract potential international investors in UK science.

In conducting the Technology Foresight Programme, the Office of Science and Technology should be encouraged to come forward with proposals that will attract international investment in UK science rather than confine its work to how it can help the UK Government and industry to make better informed decisions.

9. *Science and the young*

The national importance of attracting young people to science, engineering and technology was highlighted in March, when Education Secretary John Patten opened a campaign to reverse the continuing trend towards arts subjects among young people in the UK.

The preparation of the Department for Education report, *Science and Maths* (Ref. 20) was sparked off by last year's falls in the numbers of A-levels candidates in science and mathematics. At its launch last month, Mr Patten announced a consultation exercise to find ways of encouraging more students to opt for science and maths.

"Science and engineering are fundamental to our country's prosperity. We need scientists and engineers" he said. "We want to see an increase in the proportion of young people taking science and maths after 16. We need a continuing flow of high-calibre students from schools and colleges into science and engineering in higher education and on into industry. This is of vital importance to the country's economic and cultural future."

Government Ministers, such as Mr Patten, are clearly very worried about the long-term effect on the UK's economic performance if young people continue to reject science subjects.

The *Science and Maths* report provides the evidence to justify these worries.

The report concluded:

—"... at A-level, it has been subjects other than science and maths which have seen the fastest increases in the proportions of the age groups achieving a pass. In that sense, science and maths seem to have proved less popular than other subjects."

—"The high proportion of 15-year-olds with a science pass (at GCSE) and the growth of this over the 1980s have not translated into a correspondingly fast growth in A-level science."

—"The proportion of science and maths A-level specialists has fallen significantly since 1980, continuing a trend that goes back to the early 1960s...".

—"...since 1980, biological and physical sciences and engineering have seen a falling share of the graduating total and this pattern is projected to continue until 1996."

Mr Patten wanted to hear what people think of the findings of this review and the further action that they think the Government and other bodies can take to encourage more young people to seek qualifications in science and maths.

Setting up the National Science Centre (at Farnborough in Hampshire) would make a good contribution, as it would signal the national importance attached to attracting young people into science.

The issue of attracting young people to science needs to be addressed urgently because many of our competitors do not suffer from it. Those other countries that have suffered from it have tackled it much earlier than this country. For example, the US National Science Foundation last year issued a report *The Federal Investment in Science, Mathematics, Engineering, and Technology Education:* Where Now? Where Next? (Ref. 21). It showed that the United States has, for the past 10 years, had programmes specifically aimed at meeting its goals in science and mathematics education. At the latest count, it was spending over $2·2 billion-a-year on these programmes.

However, President Clinton was not satisfied with the results of all this expenditure, as "scientific literacy" in the United States is still well behind Japan and its other competitors in Pacific Rim countries.

President Clinton's Expert Panel recommended bringing about true reform by improving co-ordination between Government departments with respect to science education—a lesson that the UK Government should take on board too.

Incidentally, President Clinton's Expert Panel highlighted the rôle for science centres in updating and renewing teachers' knowledge of science for the curriculum and science teaching practices.

By setting out to capture the interest of young people with hands-on exhibits and modern communications techniques, a National Science Centre could help address the problem of attracting young people to science in the UK.

The need to capture young people's interest in science would be even more necessary if the Government was to take up the recommendation of the Confederation of British Industry, which has called for the target for the number of young people graduating from higher education by the year 2000 to be 40 per cent (Ref. 22).

Only if the UK Government effectively tackles the issue of attracting an increasing proportion of young people into science, will it be able to promote the UK to potential international investors in science.

Only then will there be a pool of well-qualified science graduates from which they can recruit—a significant comparative advantage in competing with those countries which have not addressed the problem.

10. *Conclusions*

1. Recent increases in international investment in UK science mask the dangers associated with the relative weakening of the overall level of investment in UK science in comparison with that in the science of the UK's international competitors.

2. It would be highly appropriate for the UK Government to introduce real incentives for overseas firms to invest in UK science.

3. It would be appropriate for the UK Government to introduce tax credits for firms to invest in UK science, with special consideration being given to the level of tax credits for overseas firms starting to invest in UK science.

4. In setting its provisions for total net Government expenditure on S&T, the UK Governmnent should take into account the adverse impact on the confidence of potential overseas investors of reduced Government expenditure in UK S&T.

5. To be successful in attracting overseas investors to set up major international R&D facilities in the UK, the Government needs to play a pro-active rôle in order to co-ordinate an integrated approach, plan for the long term, and invest for the future.

6. In conducting the Technology Foresight Programme, the Office of Science and Technology should be encouraged to come forward with proposals that will attract international investment in UK science rather than confine its work to how it can help the UK Government and industry to make better informed decisions.

7. Only if the UK Government effectively tackles the issue of attracting an increasing proportion of young people into science, will it be able to promote the UK to potential international investors in science.

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2. Science and Technology Committee, House of Commons *The routes through which the Science Base is translated into innovative and competitive technology* (HMSO, 1994), page lii, para. 173.

3. HM Government *Competitiveness: Helping business to win* (HMSO, 1994), pages 90–93.

4. *ibid,* page 94.

5. *ibid,* page 96.

6. Science and Technology Committee, House of Commons *The routes through which the Science Base is translated into innovative and competitive technology* (HMSO, 1994), page lii-liv, paras. 176–180.

7. *ibid,* page liv, paras. 181 and 182.

8. *ibid,* page lv, para. 186.

9. *ibid,* page liv, para. 181.

10. *Laboratory News,* Comment, 16 October 1989, page 3.

11. HM Government *Forward Look 1994 Statistical Supplement* (HMSO, 1994), page 8.

12. *ibid,* page 30.

13. Alex Crawford, *Defence Research Agency and civil activities,* Evidence submitted to the House of Lords Select Committee on Science and Technology Sub-Committee II, 15 March 1994.

14. Rushmoor Borough Council, *Rushmoor Local Plan Review Issues Paper—Farnborough Aerodrome* (Rushmoor Borough Council, May 1994).

15. Michael E. Porter, *Competitive strategy* (Free Press, 1980), page 275.

16. HM Government *Competitiveness: Helping business to win* (HMSO, 1994), pages 97 and 98.

17. Michael E. Porter, *Competitive strategy* (Free Press, 1980), pages 278–287.

18. HM Government *Competitiveness: Helping business to win* (HMSO, 1994), pages 71–73.

19. *ibid,* page 74.

20. Department for Education, *Science and Maths* (DFE, March 1994).

21. National Science Foundation *The Federal Investment in Science, Mathematics, Engineering and Technology Education:* Where Now? Where Next? (NSF, June 1993).

22. Confederation of British Industry, *Thinking ahead: Ensuring the expansion of higher education into the 21st century* (CBI, June 1994).

Evidence from the Insititute of Biology

This is a difficult document to respond to as some information is clearly factual and should be available already. Other questions are subjective and can only be answered on that basis.

With regard for the Call for Evidence,

Question 1, we feel this information is probably available but may require extensive inquiry to determine the extent of overseas investment accurately.

Question 2, investment in the UK requires that the recipients—at whatever level—are world class and offer excellence in science. Value for money is probably not an issue if that quality of scientific endeavour cannot be matched elsewhere. The UK therefore requires world class industrial companies, research institutes and universities.

To achieve these strengths a long-term policy of investment is needed that will look well into the future (middle of the next century at least). However, routine research programmes will be placed with the lowest bidders. In the industrial sector, it is essential that even the SMEs understand the nature of the world market in which they are likely to be operating in within the next 10 to 20 years.

Question 3, the benefits that will accrue in the UK are increased prosperity based on the applications of science and technology. It is essential that protection of intellectual property rights are safeguarded but investment from abroad may be difficult to achieve on an equitable basis. This is an issue of the highest priority as overseas investment will not come if IPR cannot be transferred out of the UK but, equally, UK personnel require adequate arrangements to ensure that some income from IPR is kept within the UK. The research councils and the DTI could well be encouraged to take a lead on this issue.

Question 4, this information if factual and should be available.

Question 5, policy implications are clear: the British Government must decide what it needs for the long-term prosperity of this country. If it is to be scientific and technical excellence sustained throughout the 21st century then we need a continuing policy of investment at all levels for the provision of skilled manpower. We already know that the UK will have no coal idustry, no car industry, no major electronic company, little or no steel industry. We may or may not have an aerospace industry or a chemical industry. The creation of a biotechnology industry now hangs in the balance. The Government must be clear what is sees as important for the industrial basis of this country and could do worse than consider the policy now being pursued by the French Government of active involvement in developing key industrial sectors. This requires investment at all levels including the provision of skilled manpower.

Evidence from Loughborough University of Technology

Comment is confined to a limited number of issues so that their importance is not diluted. Reference to these issues provides evidence on (i) the nature of overseas investment, (ii) reasons for investment and (iii) reciprocal benefits gained.

1. *Introductory Statements*

1.1 Interchange of concepts and findings on a global scale is a prerequisite of high quality research. As stated by Mark Richmond, "the International research fraternity of Science is often stronger than the National one" (HL Paper 12-I).

1.2 Loughborough University of Technology has prime research strengths in Science and Engineering and has a research ethos which values highly relevant research (primarily of a basic or strategic nature) which can be exploited by industry and commerce; this makes its research base attractive to overseas investors.

2. *Opportunities and Threats to the Nation*

Traditionally the UK has fostered very high quality research leading to new scientific knowledge. However, it has been far less successful in commercially exploiting that knowledge. *This presents important opportunities for overseas investors who potentially are our competitors, many of whom have seized upon that opportunity.*

The recent Government White Paper on Science and Technology says much on this matter. Experience at Loughborough has emphasised the following constraints on research exploitation within the UK.

(a) Strong and close research collaboration with UK commercial and industrial enterprises (the intensity of which has grown considerably over the last decade) is the norm. However, seldom will the leading vendor of technology in that arena be UK owned; this is particularly evident in the fields of computer science and industrial and commercial machinery, where the UK's indigenous base of world-class equipment manufacturers has dwindled markedly. Hence, successful examples of exploitation have often been confined to the sphere of influence of major "users" rather than "vendors".

(b) Globalisation and depressed markets have driven UK commercial and industrial organisations to short-termism, so that they are not inclined to invest in long-term projects which would enable a step change in practice. White Paper initiated changes in organisations such as the DTI may help technology transfer processes, however this inevitably will not have a marked effect. Rather investment programmes are required to facilitate risk taking in vendor organisations and create innovative technological products from research findings.

More recently aspects of funding UK Science and Engineering research have become more focussed along thematic lines. Also the role of inter-disciplinary research has been recognised in connection with wealth creation. This may improve exploitation opportunities in the UK, but UK universities and research organisations have contributed strongly to EC research programmes. However, in view of their initially stronger vendor base certain other EC countries (particularly Germany) may derive a greater payback on their investment than the UK; this phenomenon being a direct overseas exploitation of the UK science base.

3. *Opportunities and Threats to UK Universities*

The strengths of the UK research base continue to be advanced by an influx of large numbers of overseas students; in certain areas of Science and Engineering overseas PhD researchers much outnumber UK ones. Our basic and strategic science has a very high reputation world-wide and we have capitalised on this and the spread of the English language. For universities it is a high priority matter that this advantage be maintained, both on academic and financial grounds. In this respect HEIs are particularly sensitive to Government policies, of both a general and scientific nature.

The UK also gains great benefit from overseas students returning to their country of origin. Clones of UK research enterprises are formed, as are liaisons with overseas commercial enterprises and governments. This represents a significant invisible export.

4. *Observations on the Reciprocal Benefits of Research Links with Overseas Nations*

With respect to the flows of "funding" and "knowledge" between (a) the UK and other technically developed nations and (b) the UK and developing nations, clear distinctions can be observed. For (a) experience at Loughborough in many of the major science and engineering disciplines would indicate a net outflow of both knowledge and funds from the UK, albeit that such flows are typically smaller in magnitude than those in (b). This unsatisfactory situation is exacerbated by the combination of strong research funding and weak exploitation mechanisms in the UK, coupled to the relatively weak position of UK vendor organisations. Conversely for (b) more balanced trading occurs; over the last two decades and beyond there has been a significant net outflow of knowledge from the UK but this has been coupled to equally significant inward investment.

5. *Statistics on Overseas Investment in Research at Loughborough University of Technology*

In the five year period up to 1993 overseas research contracts and grants placed at Loughborough increased by 50 per cent (to over £2.5 million per annum). Also in the same period overseas student fee income in Science and Engineering doubled to over £4 million per annum (approximately 5.5 per cent of turnover in 1992–93), where at least an equal sum of money will have been made available to the local community.

Consistently over the last five years, overseas postgraduate research students have formed approximately 50 per cent of the total number of students registered for a Loughborough research degree.

The University enjoys very strong collaborative links with research organisations around the globe; this forms an integral part of our culture.

Q1 *Please describe the extent and manner of overseas investment in your departments concerned with science and technology. We are interested both in research and in post-graduate students. Is overseas investment concentrated in particular disciplinary areas?*

Loughborough University of Technology (LUT) attracts students from all over the world but the greatest numbers come from the Far East and the European Union (*see table of students by domicile*). The majority of these come to do engineering and science (*eg table of courses attended by students from the Far East*). The impact of these students is most marked at postgraduate level: for example 21 per cent of all research students are Overseas Students as distinct from 3.8 per cent of all undergraduates (*see tables of LUT's registered student populations*).

As regards research, LUT has relatively few instances of overseas companies placing contracts directly with Departments. Our patterns of overseas investment comes mainly via students and European Community contracts. The table on *Income from Research Grants and Contracts* shows the importance to LUT of European contracts with little from Other Overseas.

[Note, however, that only 39.4 per cent comes from the Research Councils and Charities. This research is mainly "basic" and "strategic". A large proportion of the rest is "applied" or even nearer market. It is this industry orientation (a niche role for LUT) which we believe attracts many of our overseas students.]

LUT's Water Engineering and Development Centre (WEDC) is a special case in point since it is an illustration of a highly successful unit which is devoted almost exclusively to overseas customers. It is an example, too of a successful unit working on low-technology problems for low and middle income countries (*see table on WEDC*).

Q2 *Do you actively seek overseas investment? How? From which countries?*

LUT actively seeks overseas investment in several ways: direct contacts with foreign Governments, Universities and companies; attendance at Education Fairs and Trade Missions; diligently seeking funding opportunities overseas and responding to Calls for Proposals. The prime countries targeted are: EU for research; Singapore, Malaysia and Indonesia for students and, increasingly, research. Joint research with foreign institutions is favoured as a means of building an ongoing partnership.

Q3 *Who are your competitors in attracting overseas investment? Are you aware of comparable investment by UK interests in academic science and technology overseas?*

LUT's competitors are other UK institutions, and universities in Australia, Japan, France, Germany and the USA (especially as regards students from the Far East).

As regards UK investment in science overseas, we are most aware of the activities of our industrial partners. For example, the large automobile or aerospace manufacturers have strategic links with overseas industrial partners and, often, through them into local overseas universities (eg, in Germany). In addition, we are aware of industrial investment in the countries of customers as part of offset agreements for large sales. Where possible, however, the UK companies try to involve UK partner universities in the teaching or research that is sponsored.

Q4 *What are overseas investors looking for? Why do they come here? What would constitute a "return" on their "investment", and do they get it? Within what timeframe?*

Overseas investors, sometimes, are seeking access to the best research teams (they never want access to poor ones!) but this is not the prime motivation for the majority of our associates. They are much more interested in issues such as: assistance with becoming self-sufficient in education, training and research; technology transfer to acquire practical skills and knowledge relevant to their local industries; improved English language skills; and the kudos of a UK degree from a university with an international reputation. As to timescales, they usually have a long-term view (eg, Malaysia's vision of being self-sufficient by 2020).

Q5 *What benefits do you gain from overseas investment in your university? What benefits does the UK gain? (direct or indirect, short-term and long-term) How does overseas investment affect your university's priorities or activities and those of individual departments? Is overseas investment different, in these ways, from investment by UK interests?*

The benefits accruing from overseas investment are varied: a supply of very high quality students enhances the general level of activities in the university; income from overseas students' fees is significant (eg, £4.4 million in 1992–93); the opportunity to work on interesting and practical problems stimulates most of our staff as does the opportunity to make contacts with other experts and cultures; and the building of better networks of academics and industrialists places us in a better position to win future projects (eg, in FPIV).

Our Departments increasingly look to the EU as a prime source of research opportunities and actively seek involvement in such ventures.

Research via the EU is very similar in nature to contract research funded directly by industry—it is ultimately aimed at wealth creation. Research for the UK Research Councils has been typically more basic and more distant from industry's needs. Research paid for by overseas countries tends to take the form of PhD studentships but with a clear concern with its ultimate commercial applications.

Q6 *How have these things changed over the last five years? How do you see them changing over the next five? What are the drivers of change? In particular, how does the current state of core infrastructure funding for the science base affect your ability to attract overseas investment?*

Over the years we have seen a steady growth in the importance and scale of non-UK research (especially from the CEC: £0.36 million in 1987–88; £2.39 million in 1992–93—see the table of *LUT Involvement in Europe*). This is expected to continue. Cut-backs in UK Government funding and increased competition for such funding makes it essential to explore other sources of funding. We anticipate that industry-led, applied research will become of greater significance as a source of income in future. More of this will come from the EU and overseas.

Publishing the Research Selectivity ratings has caused major problems for LUT's dealings with many overseas Governments (and UK companies). Most do not appreciate that the ratings are very narrowly restricted to basic and strategic research. To the extent that many of LUT's customers are more concerned with applied or even nearer market research, they have tended to misperceive the relevance of the ratings. We have lost work (students and research projects) from some countries precisely because we did not gain a high rating in some of our more applied Departments. All our Departments undertake basic and strategic research and some are justifiably rewarded by high ratings but, overall, we would welcome the introduction of a more industry-relevant rating undertaken independently of the Research Councils (by the OST, DTI or CBI perhaps?). That would ensure that we could convey a more balanced and complete picture of the UK's abilities to the outside world.

Q7 *What happens to intellectual property rights (IPR) arising out of research conducted by your departments but funded by overseas interests? Are patentable outcomes the rule or the exception?*

LUT tends to adopt a pragmatic view that the person who pays for the research owns the IPR. In that sense, we prefer to win projects and attract quality students than to create products. We have a well-established subsidiary company—Loughborough Consultants Ltd—which actively pursues the protection and onward exploitation of IPR—but the University simply cannot afford to protect everything fully. Nor can we afford to onwardly develop many inventions. The costs are too great to take the risk. Instead, we protect what we judge to be the "best bets" and seek partnerships with industry which result in us having the right to share the royalties should these arise.

That said, a variety of rules is imposed by a variety of funding sources. In some we automatically sign away any IPR: in others we automatically acquire them. That does not alter, however, the difficulty in moving to commercial exploitation.

The Sub-Committee may care to note that we occasionally get approaches from overseas countries to onwardly exploit any IPR we do not wish to exploit ourselves. These are judged on a case-by-case basis and the number of such requests is quite small but we can imagine that this might grow. For instance, we were asked whether we would be willing to become linked with a possible Science Park in Korea which would explicitly feed upon UK universities' IPR. This has not come about, yet, but we can imagine more such requests in future. If it happened, we would have to look at such arrangements quite seriously—especially if there seemed to be no exploitation route available in the UK.

Q8 *What is the extent of your involvement with "Science Parks"? Do overseas firms deliberately locate R&D in your area with a view to making fruitful contacts with your departments? Do you/would you welcome this?*

LUT is currently involved in creating a Science Park at Loughborough in collaboration with British Gas (whose new Gas Research Centre has been sited adjacent to the University). It is too soon to know how this will develop and whether we shall attract overseas firms. Marketing the new Science Park in Europe and elsewhere is part of the commercial strategy and its proximity to the University, Gas Research Centre and other high-tech industries locally is a major part of the sales pitch.

The possible link with a Science Park in Korea has been mentioned. In addition, we have received requests to assist in finding UK companies to invest in Science Parks overseas (eg Malaysia). We are actively helping with such requests since they strengthen the mutual links between the countries, companies and the University with an eye to future teaching and research.

LUT Students from Overseas by Domicile

(as at January 1994)

Far East		
eg	Singapore	212
	Malaysia	113
	Hong Kong	39
	Thailand	12
Europe		
eg	Germany	73
	France	57
	Greece	43
	Ireland	35
	Netherlands	18
	Cyprus	18
	Spain	16
	Belgium	11
	Gibraltar	8
Middle East		
eg	Saudi Arabia	14
	Iran	9
	Jordan	8
	Turkey	7
Asia		
eg	China	21
	India	10
	Pakistan	8
North America		
eg	Canada	14
	USA	11
	Mexico	9
Africa		
eg	Kenya	37
	Nigeria	18
	Uganda	8
	Zambia	8
	Zimbabwe	7
Others (less than 7 from each country)		165

Loughborough University of Technology (LUT) attracts students from all over the world but the greatest numbers come from the Far East and Europe. Note that not all of these are Overseas Students for funding purposes.

Students from the Far East: Courses Attended

(as at January 1994)

	Chem Eng Chemistry	*Civil Eng*	*Elect Eng*	*Manuf Eng Mech Eng Materials Trans Tech*	*PE Sports Science Rec Man*	*Others*	*Totals*
Singapore	5	8	71	83	37	8	212
Malaysia	14	13	25	34	—	27	113
Hong Kong	3	9	4	11	6	6	39

Only the largest countries and courses (by number of non UK students) are shown by way of indication. Far Eastern students predominantly come to LUT for Engineering.

LUT Registered Student Population in Pure and Applied Sciences, Engineering and Science and Engineering Foundation Studies (as at January 1994)

Undergraduates	Home (including EC)	3,243
	Overseas	277 (3.8 per cent of all undergraduates)
Taught Postgraduates	Home (including EC)	347
	Overseas	123 (9.5 per cent of all taught postgraduates)
Research Students	Home (including EC)	301
	Overseas	163 (21.7 per cent of all research students)

(Source: LUT Statistical Digest, 1994)

The majority of students from overseas come to do engineering and science at Loughborough. The importance of these high-quality students is most marked at PhD level where they constitute about one third of all engineering and science research students and about one fifth of all research students in the University as a whole.

LUT Registered Student Populations (as as January 1994)

	Undergraduates		*Taught Postgraduates*		*Research Students*		*Totals*
	Home and EC	*Overseas*	*Home and EC*	*Overseas*	*Home and EC*	*Overseas*	
Pure and Applied Science, Engineering and Foundation Studies	3,243 (44.0%)	277 (3.8%)	347 (26.7%)	123 (9.5%)	301 (40.0%)	163 (21.7%)	4,454 (47.3%)
Human and Environmental Studies	2,787 (37.8%)	91 (1.2%)	317 (24.4%)	28 (2.2%)	151 (20.0%)	60 (8.0%)	3,434 (36.4%)
Education and Humanities	940 (12.8%)	30 (0.4%)	450 (34.6%)	34 (2.6%)	52 (6.9%)	25 (3.3%)	1,531 (16.3%)
Totals	6,970 (94.6%)	389 (5.4%)	1,114 (85.7%)	185 (14.3%)	504 (67.0%)	248 (33.0%)	
	7,368 (100%)		**1,299 (100%)**		**752 (100%)**		**9,419 (100%)**

(Source: LUT Statistical Digest, 1994)

Loughborough is a medium sized university but without faculties of Law or Medicine. Accordingly, science and engineering are proportionately more conspicuous than they would be at most "old" universities. Just under half of all students do science or engineering—more if one includes some of the more social sciences. LUT trains approximately 5 per cent of all Chartered Engineers in the UK.

LUT Income from Research Grants and Contracts (1992–93)

Income	*£'000 1992–93*		
UK Research Councils	5,245	(35.9%)	39.4%
Charities	511	(3.5%)	
Central Government	3,092	(21.1%)	
Local Authorities	23		
Public Corporations	179		
Industry and Commerce	2,346	(16.0%)	
Health and Hospital Authorities	41		
Other sources	605		60.6%
European Community	2,388	(16.3%)	
Other Overseas	195	(1.3%)	
Total	**14,625**		

(Source: LUT 1992–93 Accounts)

Loughborough University of Technology (LUT) operates within something of a niche market for its services compared with many universities. Not only are science and technology unusually prominent but, also, applied research is pursued as vigorously as basic and strategic research. This is illustrated by the accounts above: "basic" and "strategic" research are mainly funded by the Research Councils and Charities (39.4 per cent of the whole); a large proportion of the remainder (up to 60.6 per cent) will be "applied" or even nearer market.

LUT's Water Engineering and Development Centre (WEDC)

Summary of income (£)

Academic Year	**1992–93**	*1991–92*
Teaching		
MSc Programmes	227,590	*285,942*
Diploma, Certificate Programmes and Short Courses	501,672	*502,570*
Research and Consultancy	319,898	*96,808*
Total	**1,049,160**	*885,320*

(Source: WEDC Annual Report, 1992–93)

WEDC is Loughborough University's main centre for teaching and research in water engineering. It has an international reputation for practical, appropriate technology engineering with strong support from international agencies (eg ODA, ILO and WHO). The courses are designed and provided primarily for experienced professionals from low and middle income countries. WEDC is the most extreme instance, at Loughborough, of a centre devoted almost exclusively to overseas customers.

LUT Involvement in Europe[1]

	Total LUT Grants/Contracts Income	*Total EC funded Grants/Contracts*	*% of Grants/Contracts Income funded by the EC*
84/85	£4.88M	£0.09M	1.8%
85/86	£5.53M	£0.14M	2.5%
86/87	£7.38M	£0.25M	3.3%
87/88	£7.60M	£0.36M	4.7%
88/89[2]	£8.95M	£1.27M	14.2%
89/90	£9.05M	£1.30M	14.3%
90/91	£9.69M	£1.50M	15.5%
91/92	£11.40M	£2.00M	17.5%
92/93	£14.63M	£2.39M	16.3%

1. This is not a fully comprehensive listing of all involvements with Europe—these are too many and too varied to cover in detail in a brief report. This table deals only with research grants and contracts.

2. The dramatic growth in 88/89 was primarily the result of certain Departments starting to seek funds from the European Community. Since then there has been a gradual and sustained growth.

29 March 1994

Evidence from Manchester Business School

In February you wrote to the R&D Research Unit inviting evidence to the above Committee and referring to a notice about the R&D Management Conference. We assume that you were referring to the 1992 R&D Management Conference, "Managing R&D Internationally", from which selected papers were published in the April 1993 issue of the journal R&D Management. We trust that you have now seen this issue, and we hope that you have found it of interest and have referred any relevant article to the Committee. The Keynote paper by Prof. Casson, from University of Reading, Department of Economics, may be of interest.

In July 1994 we will again host the R&D Management Conference in Manchester; see enclosed information about the theme—"Managing Human Resources in R&D". We are not, at this stage, aware of any paper to be presented which will examine international investments in science although there will be several papers about university-industry interactions and the "HR" implications.

In 1993 the Conference was held in Zurich and from those papers we selected the following paper to be published in the April 1994 issue of the journal: "The Internationalisation of Research and Development by Japanese Enterprises", by Robert Pearce and Marina Papanastassiou. These authors are from the same department as Prof. Casson. We believe that you will find their paper of particular relevance to the work of the Committee.

Please find enclosed a submission which focuses on the establishment of technical centres and their proximity to manufacturing sites. This factor has been examined as part of a study into the importance of "time to market" in new product development and has implications for future international investments in science.

Executive Summary

The implications of overseas companies' technical centres in the UK on the British economy are discussed together with possible courses of action for the British Government. The paper argues that:

1. Traditional direct incentives for overseas companies establishing technical centres in the UK are of limited value.
2. The exporting of science and technology is of limited value to the UK economy and should not be promoted without also organising to encourage the identification of additional exploitation opportunities.
3. Companies establishing technical centres to support their British manufacturing plants should be actively encouraged. Overseas companies have established, and will establish, technical centres in the UK because of its skilled technical work force.
4. The increasing importance of time to market and the increasing use of co-located multi-functional teams should not be ignored. These trends result in the need for companies to have regional technical centres and regional manufacturing plants.

Discussion

Overseas companies have been investing in the UK since the end of the Second World War. Large scale investment in industry started in the 1960s and came from the very large companies in the USA. Other countries followed in the 1970s and 1980s. These companies are now classified as multi-national. Overseas investment in UK science has generally followed the investments in industry.

Work at Manchester Business School suggests that companies establish technical centres overseas for one of two reasons. In the majority of cases the large companies established research and development (R&D) laboratories and design centres to support the regional manufacturing plants and the local market. Alternatively, overseas R&D laboratories are established to network into the host countries' local skills and knowledge base. The scientific knowledge gained is exported back to the parent company and country to develop and exploit.

When a company establishes an overseas R&D laboratory or design centre to support a manufacturing plant a large proportion of technical staff are likely to be host country nationals. Technical centres are generally relatively small compared to manufacturing plants. Consequently, a relatively small technical centre could support a relatively large manufacturing plant. The manufacturing plant could be directly responsible for many local jobs and indirectly responsible for many more. A technical centre with a brief to exploit local skills and knowledge is likely to employ a relatively few number of local technical staff. When a technical centre supports a manufacturing plant most of the communications are with the manufacturing plant and when a technical centre exports information to the parent company most of the communications are with the parent company.

It would appear that having overseas technical centres exporting British skills and knowledge and exploiting them in their parent countries is of limited value to the UK economy compared with the business development opportunities that could be generated.

The locations of an international company's technical centres depends on a number of factors. These include:

1. The history of the company in terms of its general evolution and its acquisition of other companies and the location of their existing technical centres.
2. National and local governments' policies on supporting investment from overseas companies.
3. The location of the company's manufacturing plants.
4. The availability of relevant skills and knowledge.
5. The language spoken in host countries.
6. The culture compatibility between parent country and potential host countries.
7. The location, size and nature of strategic markets.
8. The existence of various trade restrictions on imports to countries.

Regarding the history of the company and the global location of a company's manufacturing plant, western governments are very much competing with each other for foreign direct investment (FDI). National governments can, and do, provide incentives for companies to invest in their country. One government's initative on direct incentives to gain FDI is easily copied by another. An amenable environment is essential for FDI but is not the most important consideration of potential investing companies.

The availability of local skills and human resources is an important factor for gaining FDI in technical centres. An individual's, a region's, a company's and a nation's skills or core competencies are gained over a long period of time and are consequently not easily copied by others. A country with superior relevant people knowledge will undoubtedly attract FDI in technical centres.

Interviews with technical managers of overseas companies in a research project at Manchester Business School revealed that many overseas companies find it hard to work proactively with some overseas countries. The problem countries do not have English as their first language and tend to be in lesser developed regions of the world. It was identified that the technical managers of overseas (especially Japanese) companies have a preference for working with British subsidiaries.

To overcome trade restrictions, especially in the automobile industry, overseas companies have or are establishing technical centres to design products with increased "local parts content". Local design is necessary for many companies because they need to work with local suppliers.

Many companies have now recognised a new dimension to competition: time. Companies with fast and responsive product development processes can rapidly respond to market changes, customer requirements and technology break throughs. These companies can demand premium prices and increase market share for the long term. The current thinking suggests that for a company to have fast development times it must be "close" to its customers and work with co-located multi-functional teams ie, marketing, design and manufacturing functions working together in one office. There is evidence of companies switching the funding of R&D projects from a corporate responsibility to business unit sponsorship. This, together with co-location, is inevitably resulting in technical centres moving from stand alone units to the manufacturing plants. However, due to economics of scale, not every factory can have its own technical centre. In some companies factories in a region (eg, Europe) are sharing technical centres. Increasingly there is movement of technical centres within regions. If technical centres are to remain in the UK and new centres be established, then the UK must be internationally regarded as representative of its region.

Although the UK is a relatively low cost manufacturer compared with other European nations it is not low cost compared with lesser developed countries. Therefore in order to compete on a global scale it needs to establish itself as the focal point in Europe for overseas FDI in technical development. It is suggested that FDI in technical centres that support manufacturing plants can and should play a significant part in the UK economy.

Andrew Cook

R&D Research Unit

28 May 1994

Supplementary evidence from the Royal Academy of Engineering

I am pleased to enclose an amended version of the transcript of the oral evidence given by Professors Besant and Clarkson on behalf of the Royal Academy of Engineering. I have not been able to contact Professor Besant and in view of the timescale for commenting the transcript is returned without his comments.

In answer to the proposed questions circulated prior to our meeting I enclose further written evidence. In response to the questions addressed in-committee I enclose a table provided by Professor Clarkson to complement the figures quoted by Professor Besant (para 566).

Lord Perry of Walton, para 567, sought further information concerning the statement " . . . formal barriers to prevent laboratories in one sector applying for funds from another . . .". This statement orginates from state owned organisations eg AEA Technology, being ineligible to apply to UK Research Councils but able to apply to foreign government departments eg USDoE. Similarly, there are restrictions on state owned organisations participating in the DTI's LINK scheme. I trust that this clarifies the point under question.

Please do not hesitate to contact me if I can be of further assistance with regard to the Committee's inquiry.

Brian G Doble

Manager, Engineering Policy

28 June 1994

University of Wales, Swansea

Research Grant/Contract Income 1990–91 to 1992–93

		Research Councils £	*U.K. Government* £	*U.K. industry* £	*Overseas (incl. EEC)* £	*Other* £	*Total* £	*Overseas* %
Civil Engineering	1990–91	134,949	62,766	147,263	260,141	13,092	618,211	42
Materials Engineering		841,568	162,739	164,645	43,010	46,316	1,258,278	3
Civil Engineering	1991-92	210,194	81,502	170,154	218,990	2,007	682,847	32
Materials Engineering		753,748	124,772	87,845	98,294	11,974	1,076,633	9
Civil Engineering	1992–93	361,135	71,723	171,790	231,411	59,128	895,187	26
Materials Engineering		847,541	49,352	125,199	64,249	42,468	1,128,809	6

Note: The above figures represent the income from each funding source during the three years in question; the figures are taken from the audited form 3 returns to the funding council.

Q3. *Would Professor Clarkson and Professor Besant like to describe the level of international investment in the work of their own departments?*

International investment in the Department of Mechanical Engineering, Imperial College.

Current levels of investment are as follows: (This is related to Grants and Contracts)

European Commission	49 per cent
Overseas Industries	7 per cent
UK Industries	17 per cent
Research Councils	11 per cent
UK Government Depts	14 per cent
UK Charities	2 per cent

Total income in 1992–93: £8.5m, and is likely to be higher this year.

The EC funded schemes such as ESPRIT and BRITE are becoming increasingly important to our Department and in general to Imperial College. Three years ago, Research Council funding was at a level of 28 per cent and EC funding 20 per cent. A large percentage of funding from UK industry comes from one company, namely Rolls-Royce, who fund a Centre of Vibrations in the Department.

It should be noted that funding for research students and some RAs are not included in the figure that I have presented. There are some 168 Research Students and RAs in my Department, who are funded by their governments or companies. More than 90 per cent are overseas and there is a growing number from countries in the Pacific region and from SE Asia, particularly from Japan, Korea, Taiwan, China and also from Indonesia, Singapore and Malaysia.

In some cases, the students are engineers with considerable industrial experience, particularly from Japan and Korea, where they come to conduct research in fields such as advanced Manufacturing Systems and Technology. My own section comprises 36 RAs and RSs of whom five per cent are British.

Finally, I have already mentioned research centres in the context of the Centre of Vibrations that is located within my Department. There are other Centres of research within the College, in which my Department participates. For example, IC-Parc is a Centre for Planning Applications, which was initiated by Professor Barry Richards in Computer Science, Professor Norburn of the School of Management and myself. At present, it is largely funded by British Airways, British Telecom and ICL. Another Centre for parallel processing in computing, that has links with many departments, is largely funded by Fujitsu. These Centres for research are beginning to attract significant investment from both overseas and UK industries.

Q4. *Examples of overseas investment*

There are activities within UK universities where UK industry is reluctant to invest in the research until it is shown to be at an advanced stage. Even then, the level of support can be pitifully small—and this is from large cash-rich companies. In my own Section, a project on small-scale electrical power generation has attracted significant investment from US institutions, as well as some financial investment from the UK. However, three large British energy companies have shown interest, but their funds for UK university investment is almost negligible. This particular project has just attracted large funding from the EC in partnership with Rover Cars for application to hybrid electric vehicles.

Q5. *Do you believe that the taxpayer is currently subsidising foreign firms? Does either of your universities operate "UK preference" in pricing research contracts?*

Many UK companies strongly resist paying full university overheads and in many cases Imperial College has had to agree to a lower overhead than is satisfactory in the interests of supporting a vital research area. In one instance, the overhead at the research department of a major UK company sponsoring work at Imperial College was nearly four times that of the College's. This company constantly refused to pay the requisite College overhead, in spite of direct intervention by the rector.

Q6. *Are problems of IPR avoidable? How do your departments handle these matters?*

As funding for universities is becoming increasingly scarce, IPR is becoming increasingly important. Imperial College is now placing great emphasis on protecting its IPR since it could be a considerable source of future revenue. This has meant that access to certain research is restricted, which is not always easy to equate with the scholarship ethic of a university and the openness that goes with scholarship. It is abundantly clear that much IPR is lost to the UK via the overseas research students. The Japanese and Korean institutions are particularly vigorous in monitoring the progress of their students.

Q7. *What can universities do to increase their income from overseas contracts and sponsorship? What would "a more entrepreneurial approach to research funding" mean in practice?*

Academics must be more amenable to raising money for their research via new methods. These may take the form of the development of a Centre of Excellence in a particular subject. This will mean a number of academics have to pool their research efforts and ideas into a centre to create an organisation that is a critical mass so that it can portray excellence and, most importantly for industry, stability.

A second, and a most exciting idea, is to attract investment from institutions, via a college- or university-based company. This does not mean using the traditional venture capital route, but choosing investors who are prepared to support university research with all that that entails. This can be a great opportunity for both the university and academic staff.

Q8. *What can the Government do to make the UK a more attractive location for inward investment in R&D? What could the Government have done to save the semiconductor R&D investment for the UK?*

Government could do more to ensure that UK R&D is supported by providing financial incentives to those who support British R&D, ie tax reductions.

Government should also work with universities to provide centres for industrial collaborative research. In Germany, the Fraunhofer Institute facilitates the transfer of technology from university research, through the critical development phase and finally to exploitation. These institutes are of considerable benefit to SMEs, who find it difficult to perform their own R&D and who often do not have the appropriate facilities for such work. In Germany, funding for these institutes is on a vast scale, but it does provide a foundation for German industry.

Q9. *Please tell us more about a Government policy of "local R&D content" in the offshore industry. Does this policy benefit the UK, or is it misguided?*

There is a need for international collaboration in research in certain fields. The oil industry is one such field where safety, pollution and maintenance are all critical areas for the industry. Governments should seek to foster such collaboration.

To gain maximum benefit from multidisciplinary international research it is essential to have one or more groups working at the frontiers of knowledge in that field. They are then able to "tap into" the worldwide network of researchers and bring into the UK the fruits of the whole international programme. This cannot just be bought in—it is essential to have a group of people who can communicate at the same academic/scientific level as the overseas workers. They are then able to assess the true importance of new advances.

Q10. *Please explain your recommendation concerning foreign takeovers and offset agreements.*

The Government should insist on adequate UK R&D participation in large offset agreements relating to major projects. Also of fundamental importance, is the maintenance of support of UK R&D in the instance when a UK company is taken over by a foreign competitor. For example, will Rover be a low-cost production unit for BMW with the R&D being performed in Munich?

Q12. *What should be done to improve our competitive position in the "market" for overseas students in engineering subjects?*

The majority of countries now have their own Universities for first degree studies. Overseas students came to this country primarily because of the perception of a quality education system. We should do all we can to reinforce that message and try to avoid practices which would tarnish the reputation. It is difficult to regulate what 100 independent bodies do out there, but it is in everyone's interest to have a tight code of practice on recruitment and on the growing schemes which franchise overseas private Colleges to offer part or even the whole of a UK degree course. This needs a national body to promote the best that the UK has to offer.

Letter from the Science Policy Research Unit, University of Sussex

Thank you for your letter of 4 February 1994 concerning the inquiry of the above-mentioned Committee. I have now had an opportunity to study the terms of reference of the inquiry and have the following observations to make.

1. Foreign investment in the UK science base is an important topic. It is clearly essential to collect data that will enable the Committee to determine the nature and extent of such investments. Ideally, it would be useful to have direct evidence of this phenomenon but so far I have been unable to find any indication that the basic data-gathering exercise has been carried out. It has certainly not been carried out in SPRU, nor to my knowledge by any other similar group.

Doubtless, this enquiry could evince some data. For example, I notice that the annual reports of each university sometimes include the grants and contracts held by the institution by source. In these cases it would be possible to determine how much money is invested by foreign countries directly in the university dimension of the UK science base. It would not be that difficult to build up a data base of this kind and it is possible that one such is already held by the CVCP. If CVCP had carried out even a preliminary analysis it would give you some idea of the extent of foreign investment in the UK science base.

2. The question of investment in the science base arising from foreign R&D investment is much more problematic. In the currently running House of Commons Select Committee on Science and Technology inquiry into the relation between innovative technologies and the science base, we have recently carried out by questionnaire a survey of firms, one element of which was to determine how much RTDD work was done outside the UK by "parent" companies. The results could no doubt be obtained from Eve Samson, but they would be difficult to interpret in terms of your current interests.

3. This leaves the question of indirect (proxy) indicators of investment in the UK science base and here there is some interesting work. I will cite two, but I could find more if you wanted to explore this dimension further.

First, there is some interesting work by Coe and Helpman (Coe, D T, and Helpman, E, *International R&D Spillovers,* Discussion Paper No. 840, Centre for Economic Policy Research London 1993) which tries to show the relationship between the growth of total factor productivity (TFP) by country and the growth in the stock of industrial R&D investment. What they conclude is that the contribution to the *growth* of TFP is much more influenced by the level of domestic R&D than by foreign investment in R&D. By extrapolation, this might suggest that foreign investment in the UK science base, if determinable, would in any case be small because firms already know that it is not a very efficient way to promote innovation.

A related point might be that given that the most innovative firms not only carry out more R&D than do less innovative ones, and that they do so locally, countries which carry out proportionately little industrial R&D would suffer most if international investments were to be curtailed for some reason. Of course, this is the case in the UK where not only has industry systematically under-invested in UK industry, but invested heavily abroad. However inefficient it may be, innovation in the UK seems to be dependent on foreign R&D investments.

Second, there has been some work done by Pavitt and Patel in SPRU on the patenting activities of national firms. For the purposes of this inquiry it may be worth noting that patents (Pavitt, see Table two below) arise in the place where R&D is done which as we have seen tends to be the home country. In the USA and Japan, the source of patents is the home country; 92 per cent for the USA and 99 per cent for Japan. In fact the UK and Holland are much lower down in this pecking order; 65 per cent and 43 per cent respectively of patents are taken out at home. This serves to strengthen the view that while companies may be multinational in product terms, R&D still tends to be carried out at home. The home base is still the site of strategic innovation and it is crucially dependent on domestic investments in R&D. Foreign investments in R&D may be increasing (we don't know how fast), but so far at least the purpose of these is not to directly stimulate technological innovation. It seems more likely that firms are willing and able to undertake R&D outside their home countries as a support for existing production and markets and in order to make contact with foreign sources of scientific and technological excellence (Pavitt). That may be so, but the evidence of Coe and Helpman suggests that the impact on economic activities so far at least has been small.

I hope you find these comments helpful. If you think I may be able to help further with your inquiry please do not hesitate to contact me.

Table 2. Geographic location of large firms' US patenting: 1981–88

Home country of large firm	Country of origin of US patenting													
	US	JP	CA	DE	GB	FR	NL	IT	CH	SE	BE	WE	Ot	Total
US: USA	91.9	0.7	1.4	2.3	1.8	0.5	0.2	0.3	0.3	0.0	0.3	5.7	0.5	100.0
JP: Japan	0.7	99.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	100.0
CA: Canada	31.5	0.2	59.2	1.5	5.6	1.0	0.1	0.2	0.1	0.1	0.1	8.5	0.6	100.0
DE: Germany	8.3	0.2	0.1	87.1	0.4	1.2	0.1	0.2	0.3	0.3	0.8	—	1.1	100.0
GB: UK	21.5	0.1	2.3	3.8	65.9	2.4	0.9	0.2	0.2	0.3	0.4	—	2.2	100.0
FR: France	3.4	0.2	0.2	2.5	0.5	90.9	0.2	0.9	0.2	0.0	0.3	—	0.8	100.0
NL: N'lands	25.0	0.4	0.2	13.3	7.7	6.0	43.4	0.3	0.8	0.6	0.6	—	1.8	100.0
IT: Italy	4.6	0.0	0.2	1.2	0.3	0.7	0.0	92.0	0.2	0.0	0.3	—	0.5	100.0
CH: Sw'land	17.0	0.6	0.1	11.7	5.2	2.1	0.2	1.1	60.3	0.2	0.0	—	1.5	100.0
SE: Sweden	5.1	0.3	0.3	13.5	1.7	1.2	2.8	1.4	0.8	71.2	0.3	—	1.4	100.0
BE: Belgium	27.0	0.2	0.0	16.7	1.9	1.2	11.7	0.9	0.2	0.0	39.4	—	0.7	100.0
WE: W Europe	12.5	0.2	0.5	—	—	—	—	—	—	—	—	85.5	1.5	100.0

Professor Michael Gibbons

Director

23 February 1994

Further letter from the Science Policy Research Unit, University of Sussex

Thank you for your letter of 28 March 1994. I apologise for the confusion in my note to you which you have correctly identified. In fact, in the relevant paragraph, I am making two different points—one based upon the work of Helpman and Coe on elasticities and another, more general one about patterns of investment by UK industry. In fact, the two are not directly connected. The latter point is an observation based upon research carried out in SPRU, in particular by Pavitt, Patel and Senker.

The problem I was trying to address in the second, more general point, refers to the facts that UK industry:—

(i) has always invested heavily overseas; and

(ii) routinely scores low in terms of international comparisons of industry-funded industry-performed R&D.

This combination of high UK foreign direct investment abroad and low investment in R&D by industry at home creates a specific problem for the UK. Firstly, it underlines the facts that if R&D investment is to increase in the UK it will in all likelihood come from abroad, unless long established patterns change. Secondly, although in the first instance FDI tends not to be R&D investment, the simple fact of setting up advanced manufacturing plant in the UK brings in its train a demand for R&D and for qualified manpower that is best supplied locally. So, indirectly, FDI does constitute an investment in the science base. But it is probably not a very efficient way to stimulate technological development at the leading edge of the most rapidly advancing fields.

To date, the argument has been that path-breaking R&D is done by the multinationals preferentially in their home countries. This may be true generally but it is not true of the UK, hence the problem described in the preceding paragraph. However, some recent work by Dr Jacky Senker in SPRU shows some changes in the patterns of R&D activity internationally. Senker concludes in her paper, "Are Multinational Companies Globalising R&D?" that:—

(i) recent changes in the nature of competition,

(ii) rapid increases in technological knowledge, and

(iii) the growing demand for QSEs (in short supply)

mean that multinational companies are now doing more R&D abroad. Some relevant evidence for this can be seen in JETRO's 1993 survey of the European operations of Japanese manufacturing companies (table attached) (*not printed*).

If these patterns do indeed become trends, then one might expect to find enhanced R&D activity being carried out by UK firms abroad, but also increased foreign R&D investment in the UK. The latter will lead directly to the stimulation of the UK science base. Conversely, policies which seek to preserve the "national" science base by inhibiting such investments could lead to the further weakening of UK science by starving it further of much of the resources necessary to work at the forefront of the most advanced technological areas. The pharmaceuticals sector may look like an exception to these trends because industry generally, including

the UK, invests heavily in the relevant parts of the UK science base, but it is the exception. This is not the case in other sectors—for example mechanical engineering, motor vehicles, electronics and increasingly aircraft—where domestic investment continues to be low. According to the argument outlined above, policy needs to be sensitive to sectoral differences but growing FDI is going to be increasingly necessary to maintain the international quality of the cognate parts of the science base.

I hope you find these comments helpful. Please do not hesitate to contact me if you would like to explore any of these matters further.

Professor Michael Gibbons

Director

13 April 1994

Letter from the University of Sunderland

The University of Sunderland welcomes the opportunity to present evidence to Sub-Committee 1. Each of the points on which you invite comment is addressed in turn.

1. From our own experience, we would expect that all Universities will be receiving some funding from overseas industry and other overseas agencies, particularly from industry in other member states of the European Union. This is not at all surprising and is to be welcomed. Science is global. National and international frontiers are not a restriction to collaboration. There is no difference in collaboration with a company located outside the UK to collaboration with a company located within the UK. The only danger arises where intellectual property is not safeguarded adequately.

2. The main factors which, in our experience, determine where the investment will take place depend on the nature of the investment. If the investment is purely to obtain entry to basic research and/or to pick up the highly successful "UK approach" to basic research (eg as with some of the Japanese pharmaceutical investment) then the investment is targeted at prestigious University departments or prestigious University towns. (Prestige may reflect real expertise or just perceived "good places".) At the other end of the spectrum, if there is inward investment to a manufacturing facility with some R&D as well then the location is determined on economic factors, and the R&D facility could indeed be located at another site which has better perceived potential for links with indigenous expertise.

3. The benefits to the overseas investor is undoubtedly access to the knowledge base and expertise of UK scientists, engineers and technologists. The advantage to the UK is that it gives an outlet to exploitation of intellectual property in addition to those existing within the UK, where most companies are "short-termist" and so are unwilling to risk a long-term strategy. The opposite applies with, for example, Japanese companies. It may be said in some quarters that the overseas investment will taint the UK's attitude of the primacy of basic research. We would refute this absolutely, the White Paper clearly stated the urgent need to produce a climate in which results from UK basic research translate more effectively into applications, to the benefit of the UK. If UK industry is not investing sufficiently then it is better to have overseas investment to give exploitation of the research than to allow industry in another country to exploit the intellectual property with no return to the UK. With regard to students, one advantage of taking overseas research students is that there is an investment in "goodwill" which could generate dividends in the long term.

4. There are inevitably potential costs to the hosts. The mechanism which this University uses, and no doubt is widely used elsewhere in the sector, is to be fully aware of the total cost (direct and indirect) of all projects. If a decision is made to charge lower than the true cost (and there may be legitimate reasons for this) then our policy is to offset this by a greater ownership by the University of the intellectual property.

5. The major policy implication for the British Government and British Science is to ensure that the inevitable increase in investment (both outward as well as inward) produces benefit to the UK. This can be achieved in three ways.

> First by ensuring that there is a national recognition of the primary dependence of the UK on science, engineering and technology and investment in the science base. This is addressed in the White Paper, although it does not fully recognise that there is an immense cultural change needed to reverse the current negative attitude in the UK towards science and technology.

Second by ensuring that UK intellectual property is fully protected and the climate produced in which opportunities for exploitation of intellectual property are positively promoted.

Third by addressing the need for overhaul of the incentives which at present lead to the UK industry being required to produce short-term gain to, eg, shareholders and financial institutions at the expense of long-term investment.

I hope these comments are of some help to the Sub-Committee. Please let me know if I can be of any further assistance.

Professor J R Brown

Deputy Chief Executive and Pro Vice-Chancellor

29 March 1994

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